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PROPOSED EXTENSIONS TO THE MANHATTAN Elevated system were outlined at a meeting of the New York Rapid Transit Commission on July 16, by the President, Geo. Gould. It was proposed to build surface trolley roads along the streets of the annexed district, with an agreement to build elevated lines in their place whenever the earnings would pay the interest on the cost of an elevated structure. It was stipulated, however, that the Manhattan Ry. Co. must be protected against substantially all claims for damages on the part of owners of abutting property. Under the law the Rapid Transit Commission would have no power to grant guarantees of this sort nor, in fact have they any power to grant franchises for surface railways at all. No action was taken upon the application by the Commission, nor does any action appear likely at present.

A NEW RAPID TRANSIT ROUTE was proposed by Chief Engineer W. B. Parsons at the above meeting, which it is believed could be built under the authority granted to the previous commission, provided the legislature amended the present law which makes obligatory the construction of the road by the city. The proposed system would comprise a four-track road from City Hall Park to 42d St., and an east side and west side branch, each of two tracks, extending to the Harlem River and 135th St., respectively, with elevated railway extensions from these points north. The estimated cost of such a system on the basis of the unit prices approved by the Board of Experts some years ago would be $21,000,000, or adding 20% to 40% for contingencies on the various items, $26,500,000. One mile sections of third track on these branches north of 42d St. would be included to permit the running of express trains. The proposal will be considered at a meeting of the Commission July 30.

A TUNNEL UNDER UNION SQUARE, New York city, is proposed by the Metropolitan Street Ry. Co. to eliminate the dangerous curve at 14th St. The tunnel would be about 520 ft. in length with masonry portals of ornate design. It would be roofed with iron beams and lined with enameled bricks, and its cost is estimated at $150,000 to $200,000. Consent to the construction of such a tunnel is doubtful, as it would interfere with the construction of a rapid transit railway on the Broadway route. If its construction is not permitted, the Metropolitan Traction Co. will put in a special slow cable to haul its cars around the 14th St. curve. The experiments now in progress with compressed air motors may also lead to an entire change of motive power, though this is considered hardly probable.

DANGERS OF FIXED POSTS NEAR MOVING CARS are illustrated by a column of the Kings Co. Elevated Ry. on Fulton St., Brooklyn, which is said to have injured 20 men during the past few months. The course of the cars is now to be changed to pass it on the other side.

AN ELECTRIC LOCOMOTIVE of 75 tons weight is to be built jointly by the Baldwin Locomotive Works and the Westinghouse Co., and will use the Wheless current collecting system controlled by the Westinghouse Co. In this system there is neither an overhead wire nor a conduit, the current is led to contact boxes projecting ⅝-in. above the pavement, and an electro-magnetic device on the car switches the current onto each box as the car passes over it. At all other times the boxes are dead. The 30-ton electric locomotive exhibited at Chicago in 1893 by the General Electric Co. has been purchased by the Manufacturers' Street Ry. Co., of New Haven, Conn., to haul freight cars from Cedar Hill, a point on the main line of the New York, New Haven & Hartford R. R., one mile from the New Haven passenger depot, to the works of the Bigelow Co., the National Pipe Bending Co., and other large manufacturers. The total length of the branch is nearly two miles, and the maximum grade 2½%. The locomotive has a rated draw-bar pull of 7,000 lbs.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred July 15, at Quincy, Ill., on the Chicago, Burlington & Quincy Ry. It was a head collision between a switch engine and freight train. Two men of the engine crews were killed and two injured, one fatally. Both locomotives were demolished. On July 16, near Littleton, N. H., a logging train consisting of locomotive and three loaded cars ran away on a grade of 400 ft. to the mile; on rounding a 10° curve the cars left the main track and ran onto a siding. Two persons were killed by jumping and two were injured. An account has been received of an accident on the Jamaica Ry. which occurred July 11, about ten miles from Anato Bay. A locomotive with six flat cars loaded with laborers was descending a steep mountain grade when the air brakes failed. The train kept the track but ran into a locomotive at the bottom of the grade; 17 persons are reported killed and 33 injured.

THE OVER-CROWDING OF TROLLEY CARS in Brooklyn, N. Y., still continues, notwithstanding the orders of the Chief of Police. On July 19 a crowded car on the Nassau line while making up time, left the track at a curve and ran into the ditch. Seven persons were injured, the conductor seriously. President A. L. Johnson is quoted as saying that there have been 2,400 trolley accidents in Brooklyn since last April.

A SODA FOUNTAIN TANK EXPLODED, July 15, in the factory at 331 East 26th St., New York city. One man was killed and two injured; 25 tanks were being charged by an automatic filling device. The tanks are of iron and the pressure used is 150 lbs.

A WOODEN HIGHWAY BRIDGE, at Canton, O., collapsed July 13. Two men with a traction engine attempted to cross, the failure occurring when the engine was at the middle of the bridge. One man was killed and the other injured.

A FALLING WATER TANK wrecked a six-story brick building at 241 Jefferson St., Chicago, July 11. The tank was located on the roof. It contained 5,000 gallons of water and fell through to the basement. The damage to the building is estimated at $7,900.

BOILER EXPLOSIONS in Great Britain during 1895 numbered 44, according to the records kept by the Manchester Steam Users' Association. In these explosions 40 persons were killed and 54 were injured. Of these explosions 29, killing 36 persons and injuring 43, were steam boiler explosions proper, while the remainder were explosions of steam pipes, heaters, kiers, etc. Only one of these explosions was of a boiler insured in the Association, and this was of trivial importance, being merely a steam launch boiler, which fractured the neck of a cast-iron chest to which the safety-valves were attached. The fracture was due to the use of the vessel as a ram to crush ice in the Manchester ship canal.

AN AMERICAN LOCOMOTIVE BUILDING PLANT is to be erected at Nijni-Novgorod, Russia, by a corporation known as the Russian-American Manufacturing Co. Mr. H. H. Hollister, of New York city, is the President of the company, Mr. E. D. Smith, of Philadelphia, is the Vice-President, and Mr. W. F. Dixon, late chief draftsman of the Rogers Locomotive Works, at Paterson, is the General Manager. The works are to be built adjacent to the Sormovo works, a large manufacturing establishment about five miles from the town of Nijni-Novgorod. Contracts for machinery for their equipment to the value of about half a million dollars have already been placed with the principal American builders of machine tools. Five buildings are being erected, from designs made by Mr. Dixon, assisted by Julian Kennedy, M. Am. Soc. M. E., of Pittsburg, and are expected to be completed this fall, and it is intended to have the shop equipment completed and ready for use by the following spring. The works are designed for an output of about 150 locomotives per annum and will employ about 1,000 men. Besides Mr. Dixon, who will have the general management of the works and an assistant, the foremen of the various departments and some of the draftsmen will be Americans, about a dozen men in all will be engaged. We are indebted for the above information to our contemporary "The Railroad Gazette."

THE GREAT SIBERIAN RAILWAY is now completed to Krasnoyarsk. During the season of 1895, 918¾ miles were built. This gives a direct route from Petersburg to the Yenesei River, a distance of 3,056½ miles. The proposed length of the Great Siberian Ry. from Chuliabinsk to Vladivostok on the Japan Sea is 4,547 miles, of which more than one-third is now completed. A large amount of work has also been done on the branches. There are now engaged upon the actual work of construction over 70,000 workmen, beside engineers and officers. Up to 1896 $32,488,000 had been expended. The plan of building across the mountains and canyons on the south of Lake Baikal, which was the most difficult feature of the whole enterprise, has been abandoned and trains will be ferried across the lake, by transfer steamers, a distance of about 20 miles.

THE IMPROVEMENT OF NAVIGATION at the Iron Gates of the Danube has been practically completed and is to be celebrated with appropriate ceremonies in connection with the thousandth anniversary of the foundation of Hungary next month. The inauguration ceremonies are to be held at Orsova, and will be attended by the sovereigns of Austria, Germany, Roumania, Servia, Bavaria and Bulgaria. The work has been in progress about five years and was described in our issues of July 11, 1891, and April 2, 1892.

THE GREAT U. S. LOCK at Sault Ste. Marie is expected to be ready for the passage of boats early next month.

NOTICE TO STOP POLLUTING THE CANISTEO River has been served upon Hornellsville, N. Y., by the town of Canisteo. The notice declares the discharge of sewage into the river by Hornellsville a nuisance.

LEGAL STEPS TO PREVENT THE DISCHARGE OF coal dust into the Schuylkill River have been taken in the name of the attorney general of Pennsylvania and the city of Philadelphia. Complaint is entered and injunctions asked against the Philadelphia & Reading Coal & Iron Co., the Lehigh Coal & Navigation Co., and four other companies. The bill alleges that the trouble arises from washing the coal as it comes from the breakers and also from washing culm from old banks. The protection of the water supply of Philadelphia is the main object of the action.

THE FILTER BEDS CONNECTED WITH THE WATER supply of Poughkeepsie, N. Y., are being enlarged by adding an area of ⅔ acre. The present beds were built with the water-works some 25 years ago, and have an area of 0.675 acre.

A SINGLE 48-IN. CAST-IRON MAIN has been recommended for the new water supply conduit for Brooklyn rather than the acceptance of either the bid for a double line of 48-in. cast-iron pipe or a single line of 66-in. steel. This recommendation has been made by both Mr. I. M. de Varona, M. Am. Soc. C. E., Engineer in charge of the Water-Works, and Mr. Peter Milne, Chief Engineer of the Department of City Works. Both of these gentlemen base their decision on uncertainties connected with the future water supply of the city and the additional cost of the steel conduit. Of course the steel conduit is the cheaper of the two, carrying capacity considered, but Mr. de Varona urges that the city is near the limit of its bonded indebtedness. The final decision of the matter rests with Mr. Theo. Willis, Commissioner of City Works, who is reported as favoring the steel, or larger main, since it can be secured at $780,000 with asphalt, and $802,000 with Sabine coating, against $677,000 for the cast-iron pipe.

THE LOWEST BID FOR TWO 48-IN. CAST-IRON water mains on Fifth Ave., New York, from 4th to 80th St., a distance of about 3¾ miles, was $452,460. This bid was made by Mr. Wm. T. Baird, of New York. There were nine other bidders. Details of the bids will be published in our next issue.

WATER POWER to the amount of 10,000 HP. is being developed at Columbia, S. C., by the Columbia Water Power Co., a concern backed by New England capital. Aretas Blood, of Manchester, N. H., well known in railway circles in connection with the old Manchester Locomotive Works, is the President; A. F. Sortwell, of Cambridge, Mass., President of the Montpelier & Wells River R. R., is Vice-President, and W. M. Upham, of Baltimore, is Secretary. The power is being developed from a water-power canal which was begun many years ago by the state of South Carolina, and was recently turned over to the city of Columbia. The power-house, 184 × 31 ft., is being built by W. A. Chapman & Co., of Providence, R. I. It will contain eight pairs of 51-in. McCormick turbines, built by the Rodney-Hunt Machine Co., of Orange, Mass., and eight large generators built by the General Electric Co. The work is expected to be completed by Oct. 1. The water-power company proposes to sell its power at $15 per HP. per annum delivered anywhere in Columbia, the above price being for units of not less than 500 HP. used 66 hours per week.

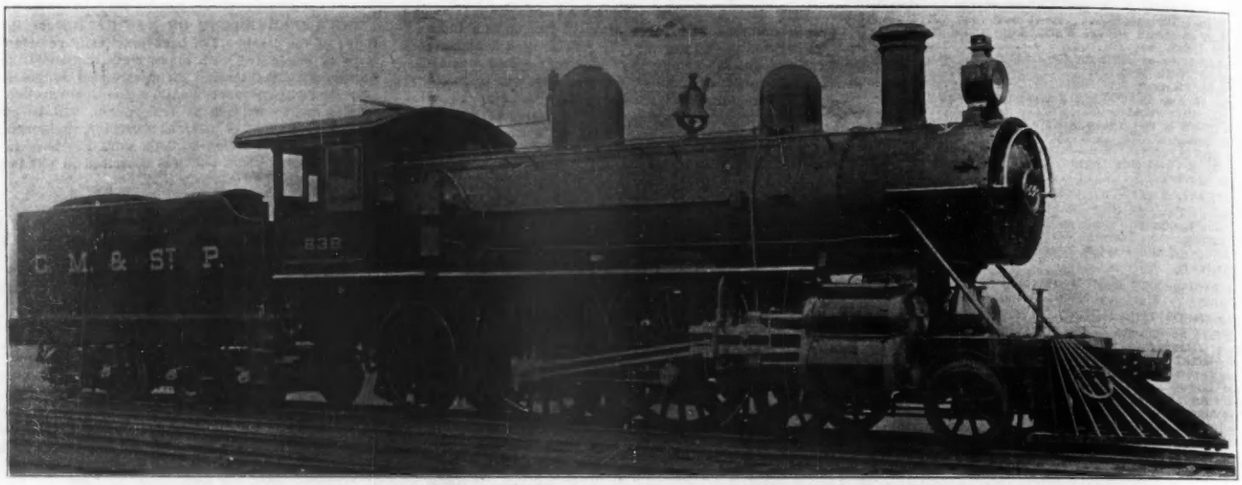
BALDWIN COMPOUND LOCOMOTIVE FOR FAST PASSENGER SERVICE; C. M. & ST. P. RY.

The Baldwin Locomotive Works has recently delivered to the Chicago, Milwaukee & St. Paul Ry., two large compound locomotives designed for fast passenger service. The accompanying illustration is reproduced from a photograph of one of these engines, for which we are indebted to the courtesy of the builders.

The locomotive is of the "Columbia" type with a trailing pony truck in the rear of the drivers, a design originated by the Baldwin Works in 1893 and used since on the Philadelphia & Reading, Chicago, Burlington & Quincy and other railways. The principal dimensions are as follows:

Gage of road	4 ft. 8½ ins.
Cylinder, diameters	h.-p., 13 ins.; l.-p., 22 "
Stroke	26 "
Driving wheels, diameter	78 "
Total wheel base	25 ft. 6 "
Rigid wheel base	13 " 9 "
Driving wheel base	6 " 9 "
Weight, total	140,700 lbs.
" on drivers	71,600 "
" on trailing wheels	29,100 "
" on trucks	40,000 "
Boiler diameter	60 ins.
No. of tubes	264
Diameter of tubes	2 ins.
Length of tubes	15 ft.
Firebox length	103 3-16 ins.
Firebox width	42⅝ "
Firebox depth	front, 71½ ins.; back, 69 ins.
Heating surface, firebox	171.0 sq. ft.
" " tubes	2,073.5 " "
" " total	2,244.5 " "
Truck wheels, diameter	36 ins.
" journals	5½ × 10 "
Trailing wheels, diameter	54 "
" journals	7 × 12 "
Tender tank capacity	4,500 gallons
" wheels, diameter	33 ins.
" journals	4½ × 8 "

On July 3, this locomotive hauled a train of 14 cars from Chicago to Milwaukee in 115 minutes, the distance being 85 miles. The train consisted of 4 baggage and express cars, 4 day coaches, 4 drawing room cars and 2 sleeping cars. The total weight hauled by the locomotive was estimated at 1,000,000 lbs. The train made two stops, at Western Union Junction and National Ave., and had a delay of five minutes at the first, which was made up in the next eight miles of the run, the train speed reaching at times, it is claimed 80 miles per hour. On another trip over the same run with 11 cars, one of which was the private car of Jos. Barker, General Passenger Agent of the Missouri, Kansas & Gulf R. R., a speed indicator on that car is said to have shown a speed of 77 miles per hour.



FOUR-CYLINDER COMPOUND LOCOMOTIVE FOR FAST PASSENGER SERVICE, CHICAGO, MILWAUKEE & ST. PAUL RY.
Baldwin Locomotive Works, Builders. J. N. Barr, Supt. of Motive Power, C., M. & St. P. Ry.

RULES FOR LOADING LONG STRUCTURAL MATERIAL ON RAILWAY CARS.

The Master Car Builders' Association at its recent meeting at Saratoga appointed a committee to report a set of rules for loading long lumber and timber, and also to govern the loading and carrying of long structural material such as plates, rails, beams, girders, trusses etc. The report of this committee has just been submitted to letter ballot for adoption, as the practice recommended by the Association for use on all railways. It is altogether probable that the letter ballot will result favorably, and that all railways will require shippers of long timber and structural material to conform to these rules. We reprint herewith in full the rules for loading structural material. As the rules for loading long timber are still more voluminous and contain several large tables, we do not reprint them, but any of our readers desiring copies of these rules can obtain them of the Secretary of the Association, Mr. John W. Cloud, Rookery Building, Chicago, after the result of the letter ballot is ascertained.

General Instructions.

1. On account of the great variety of form and weight of long structural material, no general rules can be made to suit all cases. The following regulations are, therefore, intended to cover only the most common forms. When material cannot be loaded in accordance with these regulations, special instructions must be asked for.

2. Cars to be used for shipments of this character must be carefully examined before loading, and all defects must be remedied before the cars are loaded. Great care must be taken not to overload cars, and in the case of very long or very heavy material the truss rods should be screwed up tight. The weight of the lading carried on any car must be governed not only by the marked capacity of the car, but also by its general construction, as well as by the number and location of the bearing pieces upon which the load rests. The regulations covering these points are given in Detail Instructions for each form of loading, and must be strictly adhered to. The only exceptions are cars which have been specially prepared for the shipment of particular forms of material.

3. Material over forty feet long carried on two or three cars must always be examined by a competent inspector before the cars are moved from the loading point. If no inspector is stationed at the loading point, the local agent must give notice to the proper authority when the cars are loaded, so that proper inspection can be arranged for. The object of such inspection is to see that these regulations have been complied with.

4. Standing room of at least 18 ins. must always be left around brake shaft at one end of the car to permit the proper operation of the brake, and at the other end of the car, when a single car is used, the lading must not project beyond the end sill, except in the following case: When the lading is too long to go inside the car, but will not extend more than 6 ins. beyond the end sill, such method of loading will be permitted, providing the projecting ends of the material will clear 6 ft. 6 ins. above the rail.

5. In all other cases when the lading extends beyond the end sill of the car, an idler must be used or the material must be loaded on two or three cars, as the case may demand, and as explained under Detail Instructions below.

6. Long iron, rails, bridge material, channels, angle irons, etc., should, whenever possible, be loaded on single gondola cars inside the end gates, which must in all cases be raised and securely fastened. Single flat cars must not be used for rails or bar iron, unless furnished with substantial end boards to prevent shifting of the load.

7. Whenever the lading is carried by more than one car, all slack between cars must be removed by the use of spacing blocks in the manner described in Detail Instructions. Cars must also be chained together in order to prevent parting in case of failure of the couplings. When cars are used which are not permanently equipped with safety chains, chains made of not less than ¾ in. iron must be passed around the body bolsters and across under sills, forming a loop back of bolster and doubling to point of coupling between the two cars, and so tie them together. These long chains must only have a sufficient amount of slack to permit the cars to curve. At interchange points chains will either be removed, or the receiving road will furnish the delivering road with chains of the same quality and dimensions as those received.

8. When either one or two bearing pieces are required they must never be placed between the bolster and the end of the car, but either between the bolsters or directly above the bolsters. When only one bearing piece is used on a car, as in Figs. 13 and 14, it must be placed at a distance of at least 12 ins. from center of bolster toward center of car.

9. All spacing blocks between cars, bearing pieces, spacing blocks between material, clamping pieces, bolsters and all braces must be of hard wood and sound in every way. Dimensions given are, however, intended to be general only, and any material that may be suitable for blocking, but which differs in dimensions from figures given, but which is of equal strength or stronger, may be utilized.

10. Height and width of lading must be governed by tunnel and bridge limits of roads over which lading is destined.

11. When two or three cars are used, cars carrying load must be considered of the same capacity as the one of lesser capacity.

Detail Instructions.

Loading of Single Cars Without Idlers.

12. Large girders loaded on flat side on flat cars must always be carried upon bearing blocks not less than 4 × 12 ins., which must be placed one over each bolster and secured to the floor with two ⅞-in. bolts. When two or more large girders are carried on a flat car, the bearing blocks must not be less than 6 × 12 ins., and fastened in the same manner to the floor. In addition, spacing blocks not less than 3 × 12 ins. must be placed between each girder. Lateral motion must be prevented by means of upright iron stanchions, driven into holes in the bearing pieces and held together at the top by not less than 2 × 6 in. planks, as shown in Fig. 2, or it may be prevented by fitting planks between flanges of the girders, as shown in Fig. 3. To prevent longitudinal motion, angle plates, 5 or 6 ins. wide by ½ in. thick, must be bolted firmly to the lower girders close to the bearing pieces, as shown in Fig. 1, or if rivet holes are not available, it may be prevented by clamps, as shown in Fig. 4. The upper girder must be held to the lower girder by diagonal flat-iron braces bolted to both girders, as shown in Fig. 1. If, however, girders are clamped together, as shown in Fig. 4, the diagonal flat-iron braces need not be applied.

Loading of Single Cars With Idlers.

13. When the lading is too long to go inside of a car and extends more than 6 ins. beyond the end sill, such loading will be permitted if an idler or idlers are provided to protect the overhanging part of the loads, as in Figs. 5, 6 and 8; but in these cases the length of the permissible overhang must be governed by the width of the lading and its height above the rail, and it must in no case exceed the figures given below, which are based on clearance required on a 20° curve, it being understood that the

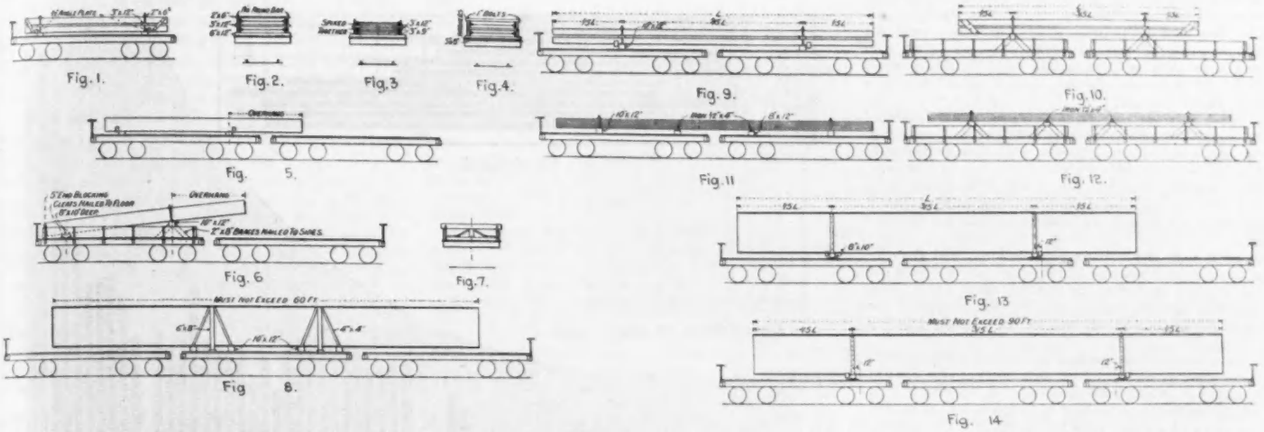
load must be placed centrally on the car and the amount of overhang measured from center of bolster on the carrying car.

For loading in accordance with Figs. 5, 6 and 8:

8 ft. wide .....10 ft. overhang.
7 ft. wide.....14 ft. overhang.
6 ft. wide, or less.....18 ft. overhang.

14. To prevent overloading of the truck under the overhanging end, as shown in Figs. 5 and 6, the carrying capacity of the car will decrease in the following manner as the length of the overhanging increases:

For overhang not exceeding 5 ft., car may carry full marked capacity; for overhang not exceeding 10 ft., car



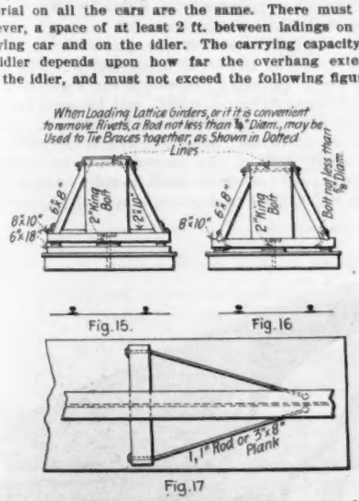
FIGS. 1 TO 14.—METHODS FOR LOADING STRUCTURAL MATERIAL ON CARS PROPOSED FOR ADOPTION BY THE MASTER CAR BUILDERS' ASSOCIATION.

may carry three-fourths of the marked capacity; for overhang greater than 10 ft., car may carry one-half the marked capacity.

15. (a) The idlers used with loads as shown in Figs. 5 and 8 must be flat cars, unless the width of the overhanging part of the lading is at least 3 ft. less than the width given for each length of overhang in the table in paragraph 13, in which case drop-end gondola cars may be used.

(b) The idler used with loads as shown in Fig. 6 may be a low-side gondola car, but must not be a high-side gondola car.

16. The idlers may be loaded with any suitable material, provided the consignee and the destination of the material on all the cars are the same. There must be, however, a space of at least 2 ft. between ladings on the carrying car and on the idler. The carrying capacity of the idler depends upon how far the overhang extends over the idler, and must not exceed the following figures,


When Loading Lattice Girders, or if it is convenient to remove Rivets, a Rod not less than ⅞" Diam., may be Used to Tie Braces together, as Shown in Dotted Lines
2" King Bolt
Both not less than ⅞" Diam.
Fig. 15.
Fig. 16
1¼" Rod or 3"x8" Plank
Fig. 17

Figs. 15 to 17.—Swiveling Bolsters for Supporting Long Girders.

except with ladings as in Fig. 6, in which the overhang may be as far above the floor of the idler as not to interfere with its lading. In such cases the idler may carry full marked capacity:

When overhang does not extend over idler more than 5 ft., full marked capacity; when overhang does not extend over idler more than 10 ft., three-fourths of the marked capacity; when overhang extends over idler more than 10 ft., one-half of the marked capacity.

17. When large girders are loaded, as shown in Fig 5, they must be secured to carrying car, as explained in paragraph 12.

18. When material is loaded on gondola cars and is longer than the body of the car, as shown in Fig. 6, one end must rest on a bearing piece not less than 10 × 8 ins., placed on the floor above the bolster and extending the width of the car. It must in all cases be of sufficient depth to prevent the lading at this end from touching the floor of the car. It must be secured from shifting by cleats nailed to the floor. The end boards at this end of of the car must be protected by blocking not less than 5 ins. thick, fitted snugly between the side boards and extending upward to a height sufficient to prevent all parts of the load from touching the end boards of the car. The other end of the load must rest upon a bearing piece, square or round, preferably square, not less than 8 × 10 ins. if square cornered, nor less than 10 ins. in diameter if round. This bearing piece must rest upon the side boards of the car directly above the bolster, and it must be securely braced to prevent both lateral and longitudinal motion, and if round it must also be braced against rolling; it must also be supported from bending. Figs. 6 and 7 show substantially how both bearing pieces are to be secured. To prevent the load from shifting in a lateral direction on the bearing piece, iron stanchions tied together with a plank at their upper ends must be used as described in paragraph 12.

19. A method of loading especially adapted to long lattice girders, which may be injured if loaded on more than one car, is shown in Fig. 8. For loads of this character four bearing pieces must be placed in pairs on the carrying car each pair being placed centrally above the bolster, with a distance apart of not over 5 ft. nor less than 3 ft.; they must be fastened to the floor with bolts, as explained in paragraph 12, and the upright supports must have side braces. Braces or tie-rods must be secured to the overhanging ends and to the bearing pieces, as shown in Fig. 17. Longitudinal motion must be prevented by the use of plates or clamps, as explained in paragraph 12.

Loading of Two or Three Cars With or Without Idlers.

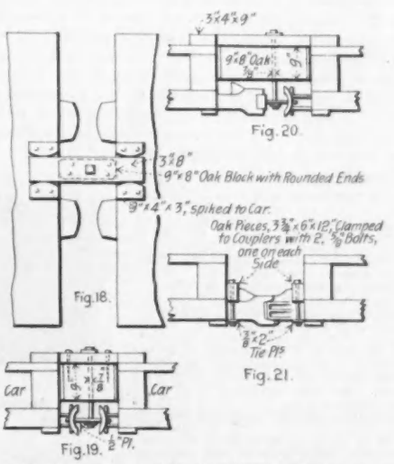
20. Material which in length exceeds the limits given for the loading of one car must be loaded on two or three cars, as shown in Figs. 9, 10, 11, 12, 13, 14. 15 and 16. With loads of this character the lading must never exceed maximums given in paragraph 26. The carrying cars must always have all slack between them removed by the use of spacing blocks, as described in detail in paragraph 28, and the cars must be chained together, as explained in General Instructions, paragraph 7.

21. Material loaded on gondola cars with drop ends or open ends or on flat cars, as shown in Fig. 9, must have one bearing piece not less than 10 ins. wide by 12 ins. deep secured to the floor of each car with two ⅞-in. bolts. Lateral and longitudinal motions must be prevented in the manner described in paragraph 12. In the case of gondola cars, a clearance of at least 18 ins. between the load and car sides must always be provided for curving.

22. Material loaded on gondola cars without drop end doors, as shown in Figs. 10 and 12, must have bearing pieces placed on the top of the side boards, of the same size and secured in the same manner as described in paragraph 18. The lading must be secured from lateral and longitudinal motions as described in paragraph 12.

23. Long flexible material, like plates, etc., must be loaded on four bearing pieces, as shown in Figs. 11 and 12. The two center bearing pieces must, however, be 2 ins. lower than the end pieces and have the flat iron ½ × 4 ins. secured on their upper side, either with spikes having countersunk heads or with two ½-in. lag-screws at each end; these iron pieces, which are intended to facilitate curving, must extend at least 1 ft. beyond each side of the lading and must be coated with grease. The bearing pieces must be secured to the car, and the material clamped together to prevent it from shifting, in the manner described in paragraphs 12 and 18. If loaded in gondola cars with drop end doors, the same clearance must be provided between the lading and car sides as specified in paragraph 21.*

24. Large girders loaded on edge, as shown in Figs. 13, 14, 15 and 16, on two or three cars, either with or without idler, must be supported on two swiveling bolsters, which may be constructed either as a double bolster (Fig. 15) or a single bolster (Fig. 16). The double bolster is preferable for wide and heavy loads on account of the better distribution of the load over the car stringers, and must always be used when the width of the lading exceeds 3 ft. or its weight exceeds one-half the marked capacity of the car. Deep girders which cannot be loaded on double bolsters without exceeding the limit in height in paragraph 13, and low girders less than 3 ft. wide, may be loaded on single bolsters, provided that the weight carried by each car does not exceed one-half of its marked capacity. When double bolsters are used, the lower piece must be securely fastened to the car floor, as described in paragraph 12, and must be not less than 6 ins. deep by 18 ins. wide. King bolts, center bearings and side bearings must be used for either kind of bolster and both center bearings and side bearings for the upper bolster must move on corresponding bearings, secured either to the lower bolster or to the floor of the car, as the case may be. When wrought iron plates are used for side bearings with single bolsters, the lower plate must be fastened to the car floor with countersunk screws or with two lag-screws at each end placed at least 12 ins. away from sides of bolsters. The girders must also be secured to the upper bolster with diagonal tie-rods or braces, as



Figs. 18 to 21.—Methods for Blocking Cars Apart.

shown in Fig. 17; if braces are used they must not be less than 3 × 8 ins. Diagonal side braces must be used between the top flange of the girder and the outer ends of the top bolster, as shown in Figs 15 and 16. When the lading consists of two or more girders standing side by side or lying on their sides, they must be securely fastened to each other as described in paragraph 12.

25. The location of the bolsters depends upon the length and width of the girders, as well as upon their stability, and they should, if possible, be so placed that the length

*If more than four bearing pieces are required to properly support the lading, the center pieces on each car must be provided with upright stanchions, as in paragraph 12.

of each overhanging end is not more than one-fifth, and the distance between the bolsters not less than three-fifths, of the total length of the girder. The following table gives locations of bolsters for girders of maximum length and width, based on clearance required on a 20° curve:

60 × 8 ft., or less, bolsters not less than 36 ft. bet. centers
70 × 7¼ ft., or less, bolsters not less than 42 ft. bet. centers
80 × 6½ ft., or less, bolsters not less than 48 ft. bet. centers
90 × 5½ ft., or less, bolsters not less than 54 ft. bet. centers

In case of material of less width than 5½ ft. but of greater length than 90 ft., applications must be made to the proper authority for special instructions.

26. To prevent overloading the following regulations must be adhered to:

(a) When only one bearing piece is used and its location is near the center of the car, as in Fig. 9. Flat cars having only two truss rods, weight of lading must not exceed one-half of marked capacity of car. Flat cars having more than two truss rods, and low side gondola cars, weight of lading must not exceed two-thirds of the marked capacity of car.

(b) When only one bearing piece is used and it is located about equal distance from center of car and center of truck, as on end car in Fig. 13. Flat cars having only two truss rods, weight of lading must not exceed two-thirds of marked capacity of car. Flat cars having more than two truss rods, also low-side gondola cars, weight of lading must not exceed three-fourths of marked capacity of car.

(c) When only one bearing piece is used, and it is located at or near the center of the truck, as on center car in Fig. 13, and on end car in Fig. 14, or on top of sides on high-side gondola cars in Fig. 10, the weight of the lading must not exceed one-half of the marked capacity of the car.

(d) When more than one bearing piece is used on each car as in Figs. 11 and 12. Flat cars and low-side gondola cars, weight of lading may equal marked capacity of car. High-side gondola cars, weight of lading must not exceed three-fourths of marked capacity of car.

27. The selection of cars to be used as idlers with loads, as shown in Figs. 13 and 14, must be governed by paragraph 15 (a).

28. The method of blocking cars apart, to be used when a load is carried on two adjacent cars, or when it is carried on two cars separated by an idler, is shown in Figs. 18 and 21, inclusive. Figs. 18 and 19 represent both the cars with ordinary drawheads. Fig 20 represents one car with M. C. B. coupler and the other car with ordinary drawhead. Fig. 21 represents both cars with M. C. B. couplers. In blocking cars apart they must first be separated by means of jacks until all the slack in the springs, couplers or links, if the latter are used, has been taken up; the spacing blocks must then be neatly fitted between the cars and secured in the manner shown. All wood used must be sound oak.

THE NEW RIFLE FOR THE NEW YORK MILITIA.

We show in the accompanying cut the breech mechanism of the Savage military rifle, which, as we stated last week, has just been selected by an able commission appointed to recommend an arm for the use of the New York State Militia. Twelve guns were submitted to the Commission for examination and tests, including such well-known weapons as the Lee and Winchester rifles. In reporting its decision the Commission gave the following high praise to the Savage gun:

> The Savage magazine rifle, lever action, magazine holding five cartridges, in strength and fineness of parts, very close compliance with the eleven "salient points" mentioned in the instructions for the consideration of the Board by the Adjutant-General, ease of manipulation and general all-round excellence, won the unanimous decision of the Board of Examiners as being clearly the best military magazine rifle submitted for their examination. We feel confident that with the Savage magazine rifle placed in the hands of the National Guard of the State of New York, a new life will be imparted to the art of target practice, great pride in the accuracy and beauty of the arm developed, and the very best weapon in the world for military purposes secured for their use.

Our readers familiar with small arms will, we presume, be able to understand the construction of the Savage gun from the accompanying drawing, which shows the lever closed. The gun can be used either as a single loader or a magazine rifle as desired. Throwing down the lever opens the breech and permits the insertion of the cartridge directly into the chamber, when the gun is used as a single loader. The lever is then pulled up, forcing the cartridge home, closing the breech and cocking the firing pin. The trigger cannot be pulled to release the firing pin until the lever is forced to its seat and the breech is entirely closed. After the piece is fired the lever is pushed down, which extracts the empty shell and throws it to the right.

The magazine arrangement is remarkably compact and simple. The bulge or protuberance below the stock, which has been a feature of most magazine rifles, has been eliminated. An index shows at a glance the number of cartridges in the magazine. For military use it is believed that a magazine containing a small number of cartridges is better than one with a large number as with the former the soldier will not be as likely to waste his stock of ammunition.

The gun is made by the Savage Arms Co., of Utica, N. Y., to whom we are indebted for the illustrations given herewith.

BREECH MECHANISM OF THE SAVAGE MAGAZINE MILITARY RIFLE.

EXPLANATION OF PARTS.

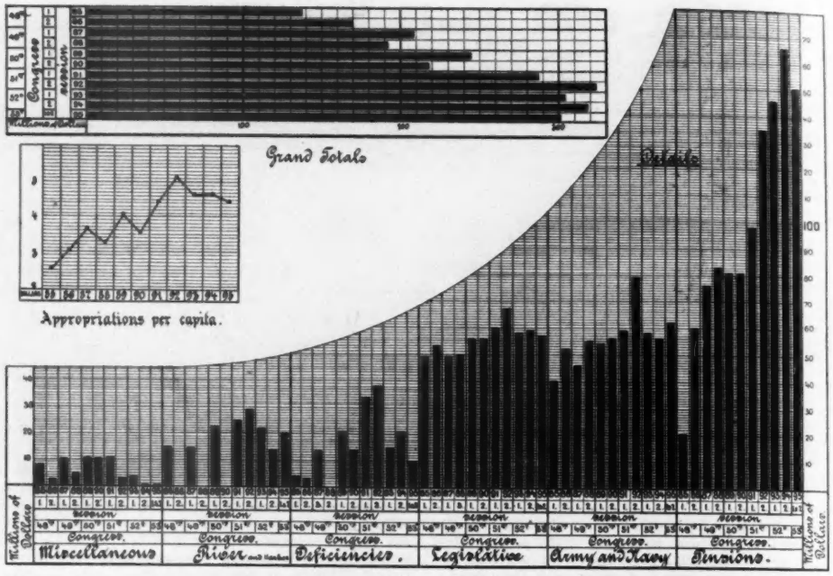
A.—Finger-lever.
B.—Catch on automatic cut-off.
C.—Automatic cut-off.
E.—Breech bolt.
F.—Extractor.
G.—Magazine carrier.
H.—Projection on receiver for finger-lever.
K.—Sear.
N.—Hammer.
O.—Mainspring.
P—Sear Screw.
R.—Trigger.
S.—Trigger safety projection.
U.—Recoil shoulder.
V.—Trigger and lever lock.
Y.—Indicator hole.

THE EXPENDITURES OF THE UNITED STATES IN ELEVEN YEARS.

We believe that most of our readers will be interested in an examination of the accompanying diagram, which we reproduce from a recent publication of the Bureau of Statistics of the Treasury Department. It shows at a glance the increase in national expenditures from $140,000,000 in 1885 to over $280,000,000 in 1891; and also the fact that since 1892 this increase has been very properly checked, although there are no signs that the total outlay or the expenditure per capita will be reduced to where it was in the early 80's.

The most interesting part of the diagram is that which shows the amount of the appropriations for different purposes. Unfortunately, the distribution is not complete, there being no means of telling, for example, to what the "deficiency" or the "miscellaneous" appropriations are applied. The different colors which in the original showed the proportion of the Legislative appropriation devoted to the Agricultural Department, the Consular Service, the District expenditures, etc., we have been obliged to omit in our reproduction.

It will be remembered that under the continuing contract system now in force, the River and Harbor appropriation represents, perhaps, a half of the present expenditure for works of this class. Even with this increase, however, it will be seen that the money spent on public works is less than half the amount required to carry on the various departments of the government, which are covered by the term "Legislative." The next division to the right represents the amount spent for national defence, which will be seen to constitute nearly a fifth of the total national expenditures. Pensions, however, are responsible for the great bulk of the increase in our national expenditures during the past decade, having risen from $20,000,000 to a present annual payment of $150,000,000 in that time. It seems practically certain that this item of expenditure will rapidly decrease from now onward, though, with the chances of future pension legislation and the possibilities of superannuation pensions being established in the civil service, it is doubtful whether the pension bill will be reduced to the figures of 1885 for many years to come, if at all.



APPROPRIATIONS MADE BY CONGRESS FOR THE FISCAL YEARS, 1885 TO 1895.

RECORD OF STEAM SHOVEL WORK; ANN ARBOR R. R.

In a paper on "Improvement Work on the Ann Arbor R. R.," *presented at the meeting of the Michigan Engineering Society, in 1895, Mr. H. E. Riggs described the improvement work which has been carried out by that railway, and the most generally interesting part of the paper was the record of work done by steam shovels in cutting down the grades. This work has been done by the company direct, using steam shovels of various makes, all having dippers of 1½ cu. yds. capacity, while the material was plowed off the cars by a Barnhart center unloader hauled by the engine of the work train. The following is an extract from the paper, and the discussion thereon. The first part of the table is the record of work done in 1894, by the Toledo, Ann Arbor & North Michigan Ry., while the second part is the record of work done during the season of 1895, when the road was reorganized as the Ann Arbor R. R.:

The past season has been one of great activity, six shovels being at work, and for a greater part of the time we have worked both day and night shifts. This fact has rather impaired the value of our statistics, as all of our measurements are based on actual pit cross sections, and it was absolutely impossible to separate day and night work. In making up the statement, a night's work is counted as a day, thus affecting the average hourly output of the shovel. Another feature of uncertainty is the fact that the number of locomotives in attendance on the shovels varied from time to time, and the record of such movements was difficult to keep. The additional fact that no form of report was used, all data being compiled from daily telegraphic reports, made it impossible to secure as complete a record as was desired.

With this general outline I would submit the table of cost. All figures represent cost of earth under the track, including all labor of shovel crew, train crew and trackmen, fuel and supplies, but do not include any figures for rental of plant, repairs, or any charges for service of telegraph, station or other employees; nor do they include engineering or superintendence (other than foreman).

It is to be regretted that there is not more literature on steam shovel work, the work of Mr. E. A. Herrmann, in Engineering News, some two years ago, being the most complete discussion I have seen. (This is now published in book form.—Ed.) Records of cost of such work, however, are rare, and these are the most valuable information that can be had, for any one about to begin work of this nature. The steam shovel and its relation to railway reconstruction has been but little discussed, but this machine has a great future of usefulness in the work of railways, as will be seen by the work done on the Ann Arbor R. R.

The average cost for moving the material for the entire time will be about 14 cts. per cu. yd. The average haul was 2½ to 3 miles. On one piece of work we hauled as high as 20 miles, and very little was hauled less than half a mile. The average haul would be fully three miles. The cost of the work would have been much reduced if we had had the advantage of a double-track railway, instead of working on a single track. It is hard to say what per cent., but the greater portion of our delays were caused by the interference of regular trains on the road. On the south end of the road, particularly south of Dundee, where we have the trains of our own road and those of the Cincinnati, Jackson & Mackinaw Ry., we have had about 50 trains per day and the delay was considerable. We had one or two instances in the district where we did not average over 3½ hours work out of a ten-hour day.

*"Michigan Engineers Annual;" 1896. Published by the Michigan Engineering Society; Secy., F. Hodgman, Climax, Mich.

RECORDS OF STEAM SHOVEL WORK.
(Toledo, Ann Arbor & North Michigan Ry.) Season of 1894.

LOCATION AND DATE.	Total Car Loads.	Total Cubic Yards.	Average yds. per Car.	Total Time Wk'd, Days	Average Car Loads per Day.	Average Cu. Yards per Day.	Net Time Wk'd, Days	Net Average Car Loads per Day.	Net Average Cu. Yards per Day.	Total Cost.	Avge Cost per yd., Cts.	Remarks.
Shovel No. 1.												
Yuma.....April 12 to May 21	4200	34706	8 26	37	113.50	938.0	25.60	164.06	1355.0	$ 3655.16	10 5/16	Sand; Short Haul.
Park Lake...May 21 to June 29	2759	23185	8.40	34	81.14	681.9	21.23	130.00	1092.0	2912.82	12 5/16	Gravel.
Dickinson's..June 30 to Aug. 6	3559	20655	5 80	31	114.81	666.0	23.87	149.10	865.3	3280.22	11 9/16	Clay. long haul.
Lake George.Aug. 7 to Oct. 3	4143	30428	7.34	48	86.31	633.9	28.66	144.56	1061.6	5118.78	16 7/16	Sand. Clay. Quicksand.
Howell Gravel Pit...Oct. 9 to Nov. 23	2898	25731	8 88	44	65.87	585 0	23.87	121.40	1078.0	4403.71	17 1/16	Long Haul.
	17559	134705								$19392.79		
Shovel No. 2.												
Oak Grove...April 2 to May 19	3911	26681	6 82	42	93 12	635.2	28.88	135.42	923.80	$ 3657.05	13 7/16	Sand and Clay.
Pettysville...May 20 to July 19	4512	31801	7.05	50	90.24	636.1	32.00	141.00	993.80	4782.32	15 5/16	Cost Divides with
Howell Gravel Pit...July 20 to Aug. 8	1947	13527	6.95	17	114 53	795.7	11.55	168.57	1171.20	1508.32	11 1/16	[New Line, Chilson
Pittsfield.....Aug. 9 to Oct. 31	5935	33534	5.65	63	94 20	532.2	44.57	133.16	752.36	6359.48	18 5/16	Clay.
Clare.....Nov. 14 to Nov. 30	1753	.....								.....		
	18058	.....								$16807.17		
Shovel No. 3.												
Byron.....May 2 to June 10	1609	6000	3 72	30	53.63	200.00	11.10	144.95	540.55	$ 2754.28	45 7/16	Wet Clay in Ditch.
Vernon.....June 11 to Aug 4	3341	19811	5 92	45	74.24	440.20	19.60	170.45	1010.76	4439.89	22 4/16	Hard Pan and Clay
Corunna.....Aug. 6 to Sept. 27	3787	25322	6 68	46	82.32	550.40	24.60	153.98	1029.34	5157.11	20 4/16	" " " "
Monroe Junc..Oct. 1 to Oct. 16	407	4170	10.25	11	37.00	379.00	3.35	121.49	1244.75	654.08	15 7/16	Sand.
Temperance .Oct. 15 to Nov. 12	1438	12984	9 02	26	55.30	499.38	9.10	158.02	1426.81	1859.66	14 7/16	Sand.
	10582	68287								$14865.02		
Shovel No. 4.												
Elm Gravel Pit....July .. to Nov. ..	7122	62480	8 77	98	72 67	637 55	53.42	133.32	1169.59	$13356.80	21 7/16	Long Haul.

Records of Steam Shovel Work (Ann Arbor R. R.) Season of 1895.

LOCATION AND DATE.	Total Car Loads.	Total Cu. yds.	Average per Car.	Total Time.	Average Car Yds. per day	Average Cu. Yds. per day	Hours Worked in Day.	Average Loads per hour	Average Cu. Yds. per hr.	Total Cost.	Cost per yd. under Track.	Character of Material.	Remarks.
Shovel No. 1 (Bucyrus S. S.)													
Millersville.....April 3 to June 20	6876	55094	8.37	68	98.19	822.56	.....	.....	.....	$3509 10	$0.0684	Sand	.....
Harrietta.....June 20 to July 13	2164	20017	9.25	19	113.90	1053.53	.....	.....	.....	1773 25	.0995	Sand	.....
Pittsfield.....July 15 to Aug. 31	4218	22926	5.70	59	68.27	558.16	.....	.....	.....	4377 61	.1331	Clay	.....
Ann Arbor.....Sept. 3 to Sept. 29	2972	16940	5.16	48	51.25	367.61	.....	.....	.....	3255 64	.1981	Gravel	Long Haul.
Milan.....Sept. 30 to Oct. 24	2490	23527	9.45	44	56.60	544.70	.....	.....	.....	3260 29	.1385	Sand	.....
Monroe Junction.....Oct. 25 to												Sand	Long Haul.
Shovel No. 2 (Bucyrus S. S.)													
Farwell, 1st Cut.....April 1 to May 14	5008	31706	6.33	88	132.31	838.47	220.53	19.25	122.33	3095 04	.0973	Sand	.....
Clare Clay Cut.....May 15 to June 21	3112	16415	5.27	31	100.39	529.55	200.50	15.52	81.87	2897 78	.1765	Clay	Hard Pan.
Farwell, 3d Cut.....June 22 to July 25	3176	2861	9.24	22	90.25	917.90	169.50	18.24	150.34	2959 55	.0995	Sand	.....
Clare Sand Cut.....July 30 to Aug. 7	715	5876	8.24	15	60.66	565.00	85.50	15.80	99.19	827 50	.0978	Sand	.....
Lake George.....Aug. 7 to Sept. 18	4518	39724	8.70	66	68.45	601.88	223.50	19.96	122.79	4160 13	.1049	Sand and Clay	.....
Cluten.....Sept. 19 to Sept. 26	1305	13260	11.00	10	63.42	667.90	71.00	16.81	185.04	1354 12	.1021	Sand	.....
Temple, Clarence.....Oct. 2 to Nov. 2	2200	17632	7.64	40	57.72	441.20	220.00	10.67	142.74	2845 33	.1505	Quicksand	.....
Temple, 2d Cut.....Nov. 3 to Nov 12	1124	9788	8.70	16	70.25	611.25	57.75	19.46	169.49	938 97	.0821	Sand	.....
Howell Gravel Pit.....Nov. 14 to												Gravel	.....
Shovel No. 3 (Marion S. S.)													
Samaria.....April 8 to April 30	717	6114	8.53	12	59.75	509.50	87.00	12.59	107.27	651 17	.1065	Sand	.....
Howell Fair Grounds.....April 31 to July 17	3570	36514	9.56	74	79.27	493.43	414.33	13.44	88.12	5117 89	.1401	Clay	.....
Howell Junction Gravel Pit ...July 18 to Aug. 7	2228	15825	7.10	32	67.85	481.97	115.50	19.37	137.70	2290 14	.1447	Gravel	.....
Pettysville.....Aug. 2 to Aug. 27	1314	10233	7.78	21	62.60	487.30	114.25	11.50	89.56	1430 36	.1398	Quicksand	Very light face
Sexton's Cut.....Aug. 28 to Sept 28	1765	14173	8.04	34	51.85	416.91	126.33	13.96	112.20	2446 52	.1724	Sand	.....
Howell Junction Gravel Pit ...Sept. 24 to Oct. 1	627	.....		14	44.79	.....	46.50	.....	.....	.....	.....	Gravel	.....
Chilson, at Station.....Oct. 1 to Oct. 4	302	2231	7.38	7	43.14	318.71	25.67	11.76	86.95	389 12	.1781	Sand & Gravel	Very light face
Howell Junction, 1 mile south.Oct. 5 to												Clay	.....
Shovel No. 4 (Marion S. S.)													
Samaria, South of.....April 22 to April 30	325	3505	11.06	5	65.00	719.00	21.83	14.86	164.68	914 86	.2544	Sand	All work lowering by hand chgd. against this cut.
Temperance .....April 27 to May 29	2874	23571	8.20	28	102.64	841.82	139.75	21.49	176.23	2546 62	.1080	Sand	.....
Pittsfield.....May 30 to July 12	3058	24478	7.97	37	68.70	656.86	174.17	17.56	140.62	2980 94	.0969	Clay	.....
Churchill.....July 15 to July 27	1184	7926	6.70	13	68.67	661.50	84.00	26.91	180.41	1074 39	.1358	Sand	.....
Bagnall.....July 30 to Aug 13	1788	16450	9.20	23	77.74	715.20	82.20	21.75	200.21	1606 63	.0968	Sand & Gravel	.....
Dairs Creek.....Aug. 12 to Aug. 21	1026	8967	8.67	15	68.40	598.13	58.49	17.57	152.34	872 65	.0980	Sand	.....
Betsey River, north) .....Aug. 21 to Aug. 30	3152	32489	10.30	32	98.50	1015.28	156.50	20.13	207.69	3444 30	.0722	Sand	.....
" " .....Oct. 25 to Nov. 5													
Crystal Lake Outlet .....Aug. 31 to Sept. 21	2181	20244	9.28	37	58.98	547.13	130.66	16.69	154.93	2264 86	.1178	Clay	.....
" " .....Sept. 23 to Sept. 30	934	10250	7.56	13	53.66	491.36	53.50	15.02	172.69	829 70	.1325	Sand	Light face.
" " .....Oct. 1 to Oct. 12	1164	13090	11.25	19	61.26	687.89	73.17	15.90	178.57	1186 86	.0969	Gravel	.....
Betsey River, south .....Oct. 13 to Oct. 30	835	8551	10.60	14	59.64	622.21	58.00	14.91	158.08	777 90	.0979	Sand	.....
Frankfort.....Nov. 6 to Nov 12	1562	16000	10.20	10	156.20	1600.00	87.50	20.46	191.77	1576 19	.1156	Sand	.....
Homestead .....Nov. 13 to Nov. 17	495	4814	9.72	9	55.00	534.80	33.91	21.60	210.12	412 96	.0858	Sand & Gravel	.....
" 2d Cut.....Nov. 18 to Nov. 28	980	5070	8.40	14	43.78	303.14	85.50	16.84	142.55	748 58	.1269	Sand	.....
Temple .....Nov. 27 to												Quicksand	.....
Shovel No. 5 (Marion S. S.)													
Dickinsons.....May 14 to June 30	1549	14630	9.44	19	81.53	770.00	.....	.....	.....	1747 63	.1194	Clay	.....
Park Lake.....June 31 to Aug. 4	3691	36919	10.24	39	92.35	946.64	.....	.....	.....	3775 61	.1022	Sand & Gravel	.....
McBain.....Aug. 6 to Aug. 9	505	4000	7.90	10	50.50	400.00	.....	.....	.....	410 04	.1022	Clay	.....
Cadillac.....Aug. 10 to Sept. 1	2304	24152	9.04	31	80.77	770.10	.....	.....	.....	1891 00	.0800	Clay	.....
Lucas.....Sept. 2 to Oct. 31	6065	59565	9.98	105	65.24	632.58	.....	.....	.....	7250 60	.1060	Sand	.....
Shovel No. 6 (Bay City Ind.)													
Derand.....July 22 to Sept. 31	4295	39206	8.20	84	51.12	419.12	.....	.....	.....	5044 26	.1432	Clay	.....
Oak Grove.....Sept. 24 to Oct. 2	409	3509	7.01	13	38.38	269.23	.....	.....	.....	1076 28	.3075	Clay	.....

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Right to Trim Overhanging Trees.

A traction company authorized by the city to erect its trolleys has the right to top the branches of trees overhanging the street when such act is reasonably necessary for the passage of its wires.—Dodd v. Consol. Traction Co. (Supr. Ct. of N. J.) 31 At. Rep. 980.

Liability of Municipal Officers.

Municipal officers will not, in the absence of malice or culpable negligence, be personally liable for damages caused by constructing a sewer across private premises under the authority of the city.—Parks v. City Council of Greenville. (Supr. Ct. of So. Car.) 21 S. E. Rep. 540.

Contract for Street Lighting.

A city, before the expiration of its contract with a gaslight company for street lighting, discarded the use of gas, and adopted electric light. The gas company continued to light its street lamps and sued for the gas so consumed. Held that it could not recover, its remedy being only for the breach of the contract.—City of Newport v. Newport Light Co. (Ct. of App. of Ky.) 30 S. W. Rep. 606.

Damages Not Limited to Bill Presented.

Where a party having sustained a personal injury for which he claims that a city is liable, presents his bill to the city council for allowance, and is by it disallowed, he may sue for and recover all damages sustained, though such damages exceeded the amount claimed in the bill, and on such judgment recover also costs.—Oklahoma City v. Walsh (Supr. Ct. Ok.) 41 Pac. Rep. 598.

Removal of Snow by Street Railways.

A city ordinance providing that when snow falls of a sufficient depth for sleighing, no snow plow shall be allowed on the tracks of a street car company, and that it shall not remove snow from its track without the consent of the superintendent of streets or mayor, does not prohibit the use of snow plows when the consent of the proper officer has been obtained.—Ovington v. Lowell & S. St. Ry. Co. (Supr. Jud. Ct. of Mass.) 40 N. E. Rep. 767.

What Must Be Shown to Recover Damages.

Where the evidence shows that one's premises abutting on an elevated railway had increased in value since the road was built, he cannot recover for damages to such premises caused by construction and operation of the road, unless he shows that there has been a general advance in the value of property in the neighborhood, not attributable to the road, of which he was deprived by the construction of the road.—Beck v. Brooklyn El. R. Co. (Supr. Ct., Gen. Term, 2d Dept.) 33 N. Y. Sup. Rep. 764.

Liability of City for Failure of Duty by Board of Health.

The duty of keeping the streets clear of putrid and other substance offensive to the sense of smell, and which tends to imperil the public health, devolves, under the charter of the city of Atlanta, upon the board of health of that city; and the functions of this department of the city government being governmental, and not purely administrative in their character, it follows that if, in the exercise of such functions, and in the discharge of the duties devolving upon this department, a private citizen is injured by the negligence of one of its servants in and about such work, no right of action arises against the city. In order to exempt a city from liability, it is not sufficient to show that the particular work from the negligent performance of which by the servants of the city a citizen was injured was being performed under the direction of the health authorities, but it must be shown that the particular work so being done was connected with or had reference to the preservation of the public health. If the health department were engaged in clearing away or removing obstructions from the street which in no way endangered the public health, the responsibility of the city then would rest upon the rule of liability for the work connected with repairing and keeping in order the public highways. It can make no difference in principle as to the character of the agents employed in the discharge of this duty with respect to the public health. The principle of non-liability rests upon the broad ground that in the discharge of its purely governmental functions, a corporate body to which has been delegated a portion of the sovereign power is not liable for torts committed in the discharge of such duties and in the execution of such powers. It can be no more liable because of the fault to select competent drivers of garbage carts than a city could be held liable for failing to elect a wise, conservative and discreet mayor.—Love v. City of Atlanta. (Supr. Ct. of Ga.) 22 S. E. Rep. 29.

BURNSIDE SHOPS, ILLINOIS CENTRAL R. R.

(With inset.)

III.

Car Shops.

In the two preceding articles describing this railway shop plant the track and ground constructions, minor buildings, buildings common to both locomotive and car work and the locomotive shops have been described and illustrated. In this article the car shops and heating system are described.

The car shops at the Burnside plant comprise six buildings as follows: Mill Building, Passenger Car Repair Shop, Freight Car Repair Shop, Passenger Car Paint Shop, Dry Kiln, and Dry Lumber Storage House. All of these buildings are grouped at the north side of the plant, and each will be described in such detail as its structural features seem to warrant.

Mill Building.—The mill building is 362 ft. 2 ins. long and 160 ft. wide, with a 45×100 ft. annex on the east side for the power plant, which runs the various wood working machines. Fig. 18 shows a transverse and a part longitudinal section, which give the roof trusses and other iron work in outline. A row of columns, 40 ft. apart, extends the length of the building at the center and carries a longitudinal truss. The roof trusses are spaced 20 ft. apart and connect at the center alternately with the columns and with the longitudinal truss. Fig. 19 shows the details of both styles and connections, and the column construction. At the outer ends the roof trusses rest on the walls to which they are anchor-bolted through oblong holes to allow of motion due to expansion. The purlins are 8×12 ins. ×22 ft. timbers, placed at panel points, and the jack rafters are 2×6 ins. timbers spaced 2 ft. c. to c. and covered with 6×1⅛ in. matched sheeting covered with "Actinolite" composition roofing. Fig. 20 shows the construction of the longitudinal truss and also the longitudinal ridge truss of the skylight frame. Other details of the skylight framing are shown by Fig. 21. The trussed purlins indicated by Fig. 18 in outline are of the same character of construction as the longitudinal center truss.

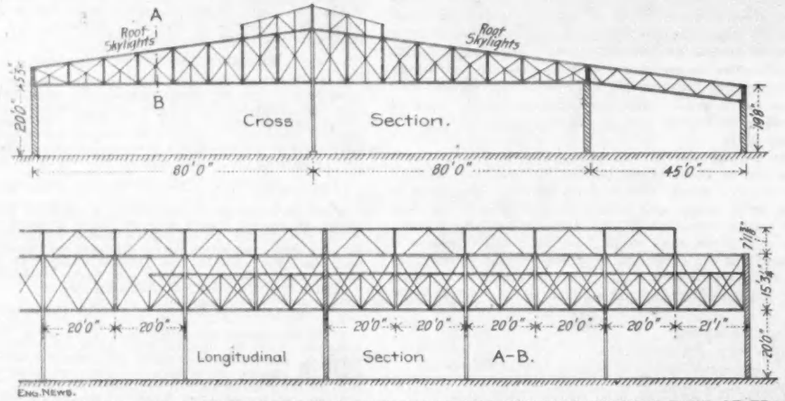


FIG. 18.—TRANSVERSE AND PART LONGITUDINAL SECTIONS OF MILL BUILDING SHOWING FORM OF FRAMING.

Besides the lantern or ridge skylight there is a row of smaller roof skylights on each side and occupying the space between panels three and four of the roof trusses, as shown by Fig. 18. The design and construction of one of these roof skylights are shown by Fig. 22. This drawing gives the construction in such detail that further description of that feature is unnecessary. This form of skylight was adopted on account of the flatness of the roof which made the ordinary form of flat skylight undesirable. Experiments showed that a slope of 1 in 4 at least was necessary to prevent the gathering and dripping of condensed moisture on the under side of the glass, and these skylights were designed to avoid such trouble.

The interior arrangement of the building is simple. At a distance of 120 ft. from the south end, the building is divided by a transverse brick firewall, having double doors of ⅛-in. sheet iron. This portion of the building is divided by wooden partitions into a truck shop, 120×60 ft., a cabinet shop, 120×60 ft., and an upholstering shop, 120×40 ft. North of the fire wall the building is devoted to general wood working machinery. In the annex or engine house are a 400-HP. Sioux City Corliss engine for running the machinery, and a 20×30 ins. duplex Rand air compressor, capable of furnishing 1,800 cu. ft. of free air per minute compressed to 150 lbs. pressure with 80 lbs. steam pressure. This air is piped to all parts of the shops and grounds for various purposes. The heating apparatus for the building is also located in the engine house.

It may be noted before leaving the description of this building that the location and arrangement of the tracks entering it and all the other buildings as well, were shown on the general plan of the whole shop plant, published in our issue of June 18. Details of the track and floor construction for the mill building, however, are shown by Fig. 24, this floor being the same in its general features as that for the passenger car repair shop described further on.

It is almost unnecessary to say that this building is used for preparing all timber used in the car repairs, it being sawed, planed and otherwise worked into shape here. Push car tracks connect it with the dry kiln and dry lumber storage house which are described further on.

Passenger Car Repair Shop.—This building is the same size as the mill building, 362 ft. 2 ins. ×160 ft., and, as in the mill building, a center row of columns carries a longitudinal truss, which, together with the columns, support the roof trusses at the center. The columns are spaced 40 ft. apart and the roof trusses 20 ft. apart. Fig. 23 shows the general design of the roof trusses, longitudinal trusses and longitudinal trussed purlins, and the interior view, Fig. 23, will aid to an understanding of the general arrangement and construction of the same parts.

The top chords of the roof trusses have a triangular lateral bracing and carry Z-bar purlins upon which are the wooden jack rafters, sheeting, and "Actinolite" composition roofing as in the mill building. The building also has the ridge lantern and side skylights, but the latter instead of being raised as in the mill building are flat. Altogether 2-7 of the roof area is glass and as a consequence the interior of the building is very light, as will be seen from Fig. 24.

The interior of this building is not subdivided, it being devoted entirely to one use, namely, passenger car repairs. A series of 18 parallel tracks with a capacity of 36 cars at one time cross the building transversely and onto these the cars are run for repair. Fig. 25 shows the track and floor construction. Between each pair of tracks the floor space is given up to racks and benches and to the use of the workmen, as shown by Fig. 24. This view also shows the piping for the heating system, the system of side doors, and minor details of construction and equipment.

These side doors are deserving of further mention, and in Fig. 26 are shown one type of double door and a push car door. The doors of the second type are of the same dimensions, but the construction is different, they being divided transversely about midway up, so that the bottom half can be opened independent of the top half. Owing to this construction the suspension rods extend from the top outside corners to the bottom inside corners of the upper doors only. The bottom windows also, instead of being the same size as the top windows, 4 ft 6½ ins. ×4 ft. 6½ ins., are only 2 ft. 5½ ins. ×4 ft. 6½ ins. There is also no wicket door in the main doors. Altogether there are 21 doors of this type, 14 of which are in the mill building.

Passenger Car Paint Shop.—This building is located just east of the passenger car repair shop, and is of the same size. A transfer table between the two buildings provides for the easy transfer of cars from one to the other. The framework of the building is also very similar in all respects to that of the passenger car repair shop. About one-half of the roof area is glass, making it very light.

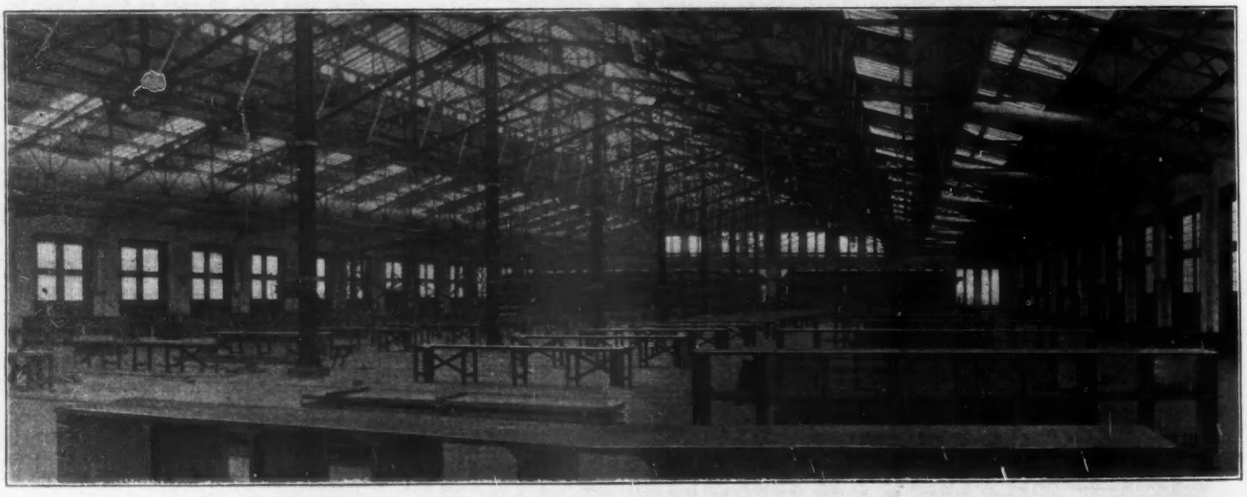


FIG. 24.—INTERIOR VIEW OF PASSENGER CAR REPAIR SHOP.

At the north end of the shop there are three small rooms, devoted, respectively, to cleaning brass work and car fittings; to the storage and mixing of paints, and to the storage and preparation of varnish. The main portion is crossed transversely by 17 parallel tracks, on which the cars are stored for painting. The track and floor construction are shown by Fig. 27. Owing to the

large amount of water used in washing and the drippings from the cars this floor is of concrete and so troughed that drainage is rapid to the sewer pipes underneath it. These sewer pipes run lengthwise of the building, one near each side and one at the center. On the lines of these pipes there are open gratings and connecting pipes between the rails of each track, and also at the center of the floor spaces between tracks. Midway between the side and center lines of pipe the floor is crowned.

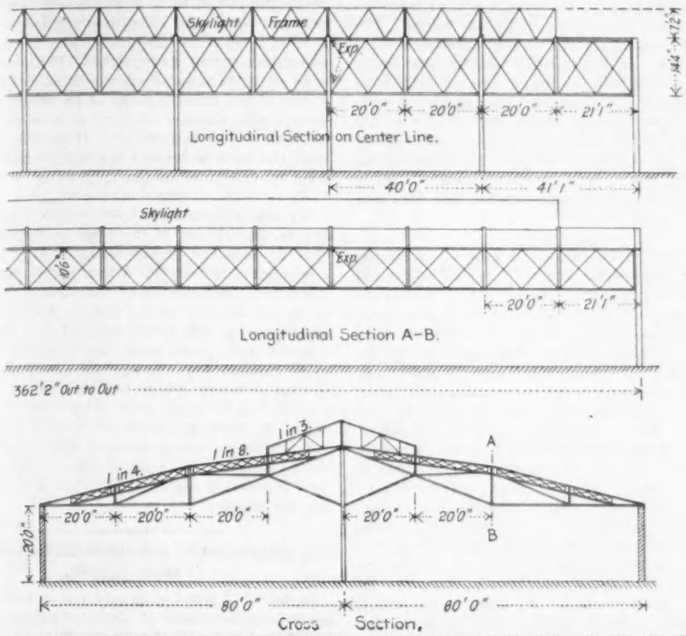


FIG. 23.—TRANSVERSE AND PART LONGITUDINAL SECTION OF PASSENGER CAR REPAIR SHOP.

Freight Car Repair Shop.—This building is 502 ft. 2 ins. long and 100 ft. wide, and the roof trusses span it from wall to wall without intermediate columns, as is shown by the interior view Fig. 28. The ridge lantern is the same as for the other buildings described, and the roof skylights are of the raised trapezoidal type already described for the mill building. Four tracks run lengthwise of the building which is not subdivided. Fig. 30 shows the track and floor construction.

The tracks in the building have a capacity of 44 35-ft. cars at once, and here all of the heavy repair work will be done. The yard tracks at the west end of the building will also be used for cars needing light repairs. Both this shop and the passenger car repair shop are thoroughly fitted with pipes for compressed air, which will be used to operate jacks, hoists, and such other power appartus as may be used.

Dry Kiln.—This building calls for attention chiefly on account of the system of drying used. At one side of the building is a small annex in which are located a Sturtevant heater and fan of the construction described farther on under the head of Heating System. From this heater a large supply pipe passes transversely across the building underneath the floor near one end. Right angle branch pipes, six in number, convey the hot air from the main pipe and discharge it through the eighteen 15-in. openings in the floor. At the opposite end of the building the hot air is exhausted into ducts which lead it back to the heater again, or it is sent to the outside—if rapid drying is desired. The lumber is run into the building on special tracks, and then subjected to the circulating hot air until seasoned. It will be seen that the system described is the well-known "Sturtevant Patent Progressive Lumber Dry Kiln," of the B. F. Sturtevant Co., of Boston, Mass.

Dressed Lumber Storage House.—This building calls for no extended description. It is used to store seasoned and dressed lumber and is 100 ft. long and 75 ft. wide.

Steelwork.—The general design of the steel framework for the different car shops has been described. Two classes of material were called for by the specifications, soft steel for rivets and medium steel for all other parts. All steel was required to be made by the open hearth or Bessemer process, and to contain not more than 0.1 of 1% of phosphorus or 0.6 of 1% of sulphur. In tests of ¾-in. diameter bars it was to show the following results:

	Ult. strength, lbs. per sq. in. Max.	Min.	Min. elastic limit, lbs. per sq. in.	Per cent. Elong.	Reduc.
Medium steel	66,000	58,000	38,000	20	44
Soft steel	58,000	50,000	30,000	28	50

The usual bending and drifting tests and a chemical analysis were also required. All material was inspected before shipment. Before leaving the mill all material was cleaned and given a coat of raw linseed oil, and after erection it was given two coats of paint.

The steel was furnished by Carnegie and manufactured by the American Bridge Works, of Chicago, Ill.

Heating System.—The immense areas of these shops introduce a problem in heating which could be solved only by a very extensive and efficient plant. After full consideration it was decided to adopt the B. F. Sturtevant Co.'s hot blast system, the essential features of which is well-known consist of the steam coils, the air duct leading all over the building to be heated and the blower or fan for forcing the hot air through the duct. The advantage claimed for this system is that the air is kept in motion and does not become robbed of its heat by coming into contact with cold walls, and other large exposed surfaces. The hot air is discharged near the floor, and in ascending is claimed to give an even temperature.

The details of the heating system differ somewhat in each building, but the general design is the same for all. Referring to Fig. 23, showing the interior of the passenger car repair shop, it will be seen that two large air pipes pass lengthwise of the building, one on each side of the roof. These two pipes are carried by the roof trusses, and from them at intervals pipes extend at right angles along the roof slope to the side walls and then bend down by means of an elbow. Hot air from the two main pipes is thus discharged near the floor at the side walls.

The heating apparatus proper consists of a rectangular system of steam coils inclosed in a box, one end of which is open for the entrance of air, and at the other end of which is placed the fan or blower. This blower is operated by an independent engine which exhausts into the steam coil and supplies the heat necessary to warm the air. The operation is obvious. Air is sucked into the box between the steam coils and then forced into the system of supply pipes. In the paint shop the air is taken from the outside to secure the best possible conditions for drying paint, but in the other buildings it is taken from within and thus is simply circulated about therein. In the freight car repair shop the fan is 20 ft. 5 ins. high and 5 ft. wide, and is run by a 8×20 ins. engine. The coil has 12,000 ft. of 1-in. pipe. In the other three car shops the fans are 20 ft. 5 ins. high and 6 ft. wide, and are run by 11½×16 ins. engines. The heating coils each have 14,500 ft. of 1-in. pipe.

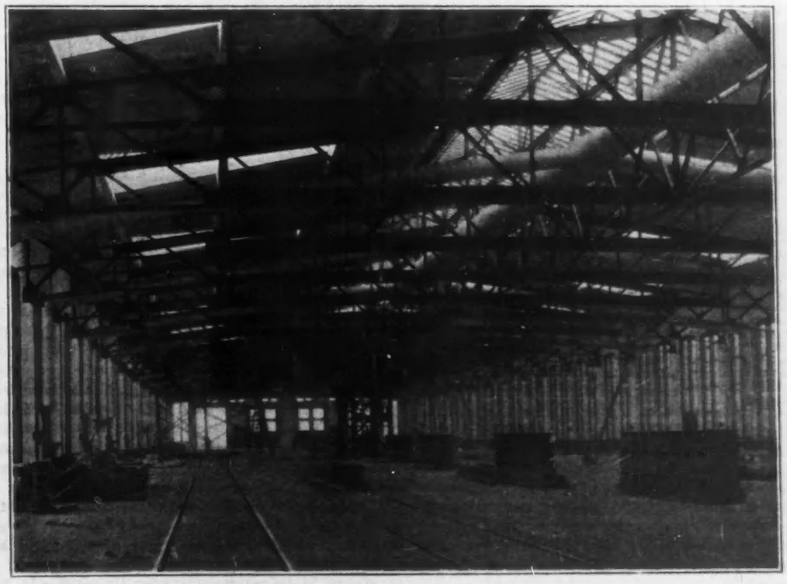


FIG. 28.—INTERIOR VIEW OF FREIGHT CAR REPAIR SHOP.

In a previous paragraph the heating plant for the dry kiln has been described.

In the foregoing paragraphs, and in the two articles preceding the various structural features of the great shop plant of the Illinois Central R. R., at Burnside, Ill., have been described. The study of the drawings presented furnish many suggestions for thought which have not been mentioned, however, and in our editorial columns some of these have been considered.

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The deficient force of the city engineering departments of many of our cities is brought to mind by some comments in the "Call," of Newark, N. J., regarding the size of the engineering corps in that city. Recent severe storms in Newark have greatly overtaxed the facilities for the removal of surface drainage. The "Call" states that the lack of proper drainage facilities has caused much loss to individual property owners and the city as a whole, and discusses the demand for larger storm sewers, the overhauling of gutters, and the protection of walks and cellars. In speaking of the work that should be done it calls attention to the need of a larger engineering staff as follows:

> The real obstacle to this is in the engineering department. There are excellent workers in this branch of the city government, but it is absurdly inadequate in the number of men and in the amount spent for engineering purposes. The city is, for instance, required at the present time to maintain a constant engineering supervision over the water-works, both as regards the old construction and the new. This will continue after the city has acquired full control, and is likely to grow greater. It now takes most of the time of the chief engineer and one assistant. For the rest of the force there is the sewerage system, the paving, the grading and opening of streets and a thousand and one details. How the two or three men available now manage to get through with the work it is hard to guess. That they could do more, yet do it thoroughly, no one believes. The city has never been willing to spend enough money in this line, and it is proving an expensive economy. More liberal ideas should control, and with the enormous amount of work under way or impending, the subject can not be considered too soon.

When a daily paper urges an increase in the engineering force of a city it may be pretty generally assumed that such an increase is needed, but it is only fair to say that this particular paper discusses public improvements with unusual discernment.

We shall not venture to discuss the needs of Newark, but the representations made by the "Call" are entirely in accord with the conditions in many other localities. Happily there are a growing number of instances where the economy of employing a sufficient number of competent engineers is recognized, and where it is also perceived that the only way to get and keep good men is to pay them ample salaries. Where large sums are being paid out yearly for public improvements a thoroughly competent engineer will save a city daily the difference between the yearly cost of his services and those of an incompetent man. Where not enough engineers, even of an indifferent character, are employed, the saving might be even more marked if such folly were abandoned and the right course pursued.

Vast improvements are being made in methods of carrying out all classes of public works. The municipality that does not employ engineers thoroughly abreast of the times is continually liable to adopt discredited methods. These will lead to heavy yearly charges for a time, and then have to be abandoned, where the proper course would have meant light annual cost for maintenance and long years of useful service. In engineering, if anywhere, "the best is none too good." There is here, as elsewhere, a limit to what one man can do and do well.

Possible further economies in railway operation and in railway service are the subject of a good deal of discussion at the present time, when competition and bad financial conditions are combining to reduce railway earnings, and such conditions are a spur to good managers to devise new methods by which they may legitimately reduce expenses and work the equipment more economically without reducing the efficiency of the service. The Erie R. R. has recently introduced two somewhat notable improvements in operation which may be expected to produce a decided economy. In the first place it has adopted the system of rating freight trains on a tonnage basis, instead of by the number of cars. This system has been very much discussed of late and the discussion has shown that under the ordinary practice there is no uniformity in the train loads, since a large proportion of the cars contain but a very small percentage of their freight carrying capacity, so that an engine hauling its full complement of cars may be loaded far below its economical capacity, while the dead load of the train is out of all proportion to the paying load which it carries. Under the new system the cars are, as far as is consistent with prompt and efficient service, loaded to the proper capacity, and the weight of the freight in each car is made out on the way bills, so that the men in charge of making up the trains can readily see how many cars may be attached to a certain class of engine. This system is found to work very well and very smoothly, even with connecting roads, and it not only tends towards economy in general operation, but also enables the locomotives to be worked under conditions more favorable to economy and efficiency of the motive power equipment.

The second improvement above noted is directly in connection with the economical operation of the motive power equipment, and consists in doubling the run of the passenger engines from Jersey City. Formerly one engine hauled a through train from Jersey City to Port Jervis, 88 miles, and then another engine took the train on from Port Jervis to Susquehanna, 104 miles. Now, however, one engine makes the through run of 192 miles, and it is easy to see that a considerable economy in fuel consumption may be expected, since the longer the engine is kept in regular service on the road (that is to say, the longer its straight run) the less will be the amount of fuel lost in banking and rekindling the fires. If an engine makes a run of 88 miles and then goes into the yard or round-house to wait for some hours before going on the road again, it will manifestly be handled to less advantage as a machine than if it makes a run of 192 miles before laying up. As to the question of repairs, there seems to be no reason why these should be increased; in fact the boiler is likely to be less severely strained if worked uniformly for a greater period of time between the banking of the fire. A few years ago, when the Strong locomotive, with double corrugated flue furnaces, was being tried on different roads, one of the claims made for it was that the use of two independent fires enabled the fires to be kept bright and the grates clean for a much longer run than was practicable with the ordinary locomotive having but a single fire. This engine, on one occasion, made the through run of over 400 miles, from New York to Buffalo, over the Erie R. R., hauling the regular day express, and returning with the eastbound express on the next day. The number of men required to feed the fires, to tend the doors, and to pass the coal down to keep a supply on the tender deck, made the run of little moment from an economical point of view, the experiment being mainly with a view to showing the practicability of increasing the direct run of locomotives. If an ordinary engine with its regular crew can successfully make a run of 192 miles instead of 88 miles, it probably means that another element in economical operation has been introduced. It is not improbable that the runs of freight engines on the Erie R. R. may be increased in the same way.

We are informed that the bridge which fell under an electric car of the Dayton Traction Co. on July 1, as noted in our issue of July 9, was not a wooden structure but a new steel bridge. What the merits or demerits of the structure may have been, we do not know; but it is evident that a steel truss is not proof against the impact of a derailed car, and that this accident ought not to be passed over merely as another case of a weak and flimsy bridge falling under a load. The lesson which these and other recent accidents ought to carry to engineers is that proper guard rail protection should be provided on all through-bridge spans crossed by electric railways to prevent a derailed car from running into and wrecking the trusses.

THE ARRANGEMENT AND CONSTRUCTION OF RAILWAY SHOP PLANTS.

Division of labor is to-day recognized as an essential characteristic of manufacturing. It has been found that in no other way can production be made so rapid and so economical in material and labor. To produce a manufactured article a number of processes are required, each different from the other, in the appliances used, and the character of skill required of its working force, but all co-operating to the same end—the production of a single, complete, marketable article. In designing a manufacturing plant, then, it follows that this differentiation of appliances and manual skill must be recognized if the best use is to be made of the mechanical power and the cunning of workmanship, of its equipment of machines and men. The railway shop plant is a kind of manufacturing plant, and the same principles which apply to the successful operation of other manufacturing plants apply to its operation.

On another page we conclude the description of the shop plant of the Illinois Central R. R., at Burnside, Ill., one of the largest and most modern plants of the kind in this country. In view of these facts it has seemed profitable to consider briefly some of the salient features of good construction and arrangement which that plant seems to exemplify, and to draw from them such lessons as may be profitable in the light of the conditions usually governing the construction of such plants.

Perhaps the first question which comes up in the construction of a railway shop plant is its location. We have already discussed this question at length in relation to general manufacturing plants, in our issue of April 9, but the conditions with railway shop plants are somewhat different. Their products are not for the general market. Like the repair shops of a manufacturing establishment, railway shops are merely an accessory to the various processes necessary to produce the marketable material, which is for railways safe and rapid transportation of passengers and freight. The location of the plant, then, has to be considered only in respect to the question as to how it will best subserve the demands of the railway to which it is an adjunct. Only in so far as that location affects its ability to produce marketable transportation is the railway company concerned with the industrial and market conditions of the country in general in selecting the location for its shops.

How to subserve best his own particular conditions is then the thing which the railway manager has to consider. The factors which enter into this problem are many, but we think they may be gathered under the following heads: (1)

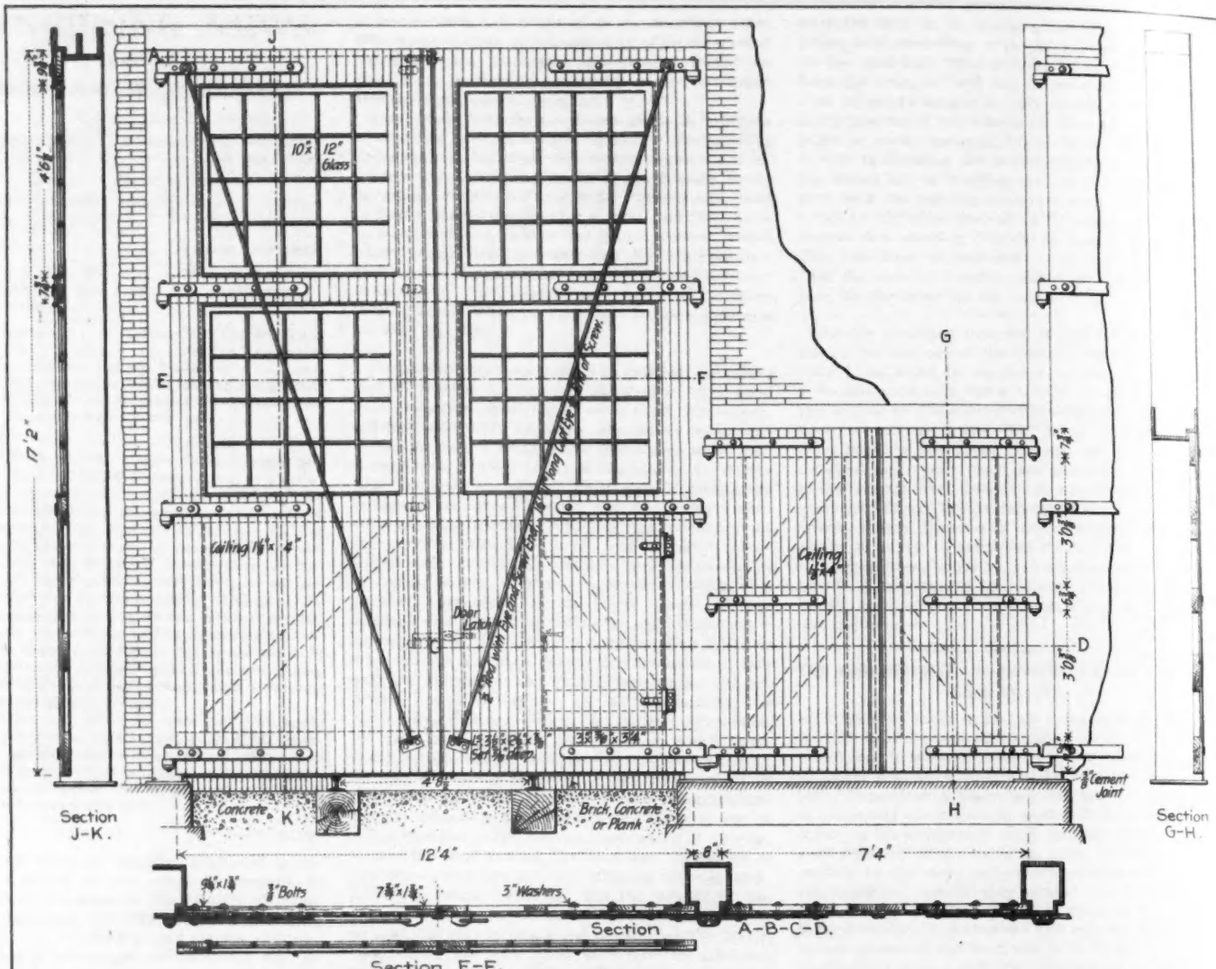


FIG. 26. DETAILS OF STANDARD DOUBLE DOORS.

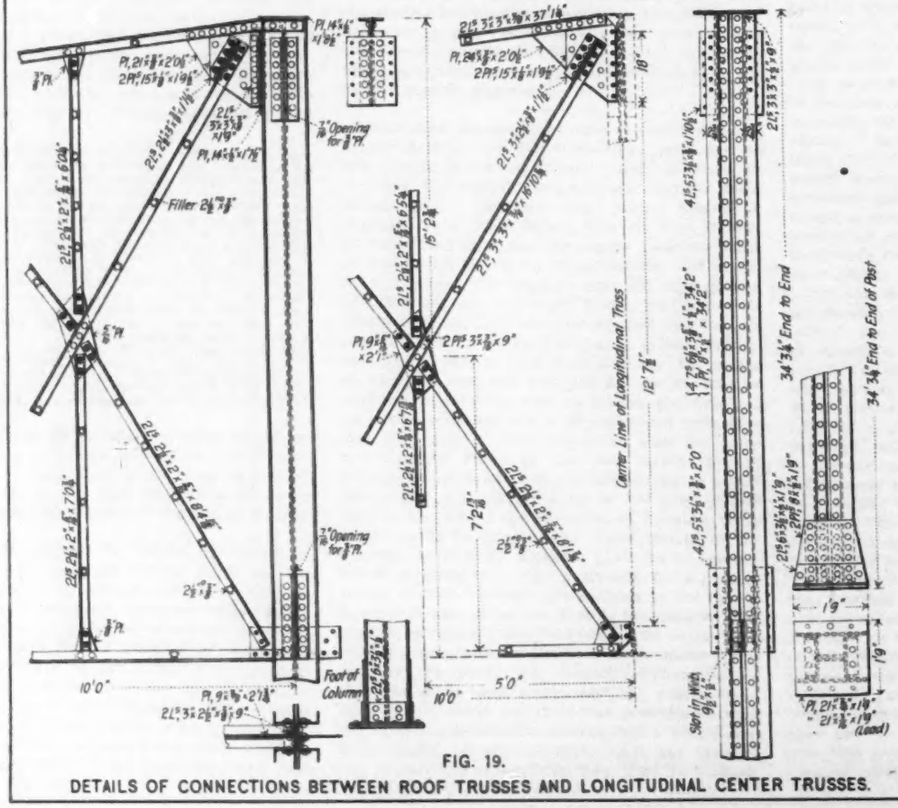


FIG. 19.
DETAILS OF CONNECTIONS BETWEEN ROOF TRUSSES AND LONGITUDINAL CENTER TRUSSES.

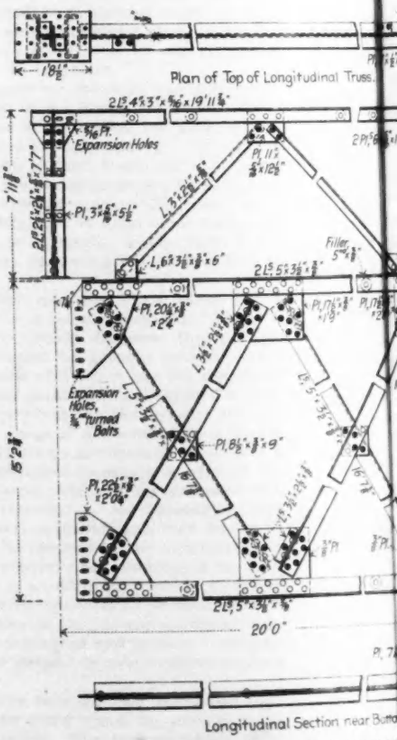


FIG. 20. DETAILS OF LONGITUDINAL

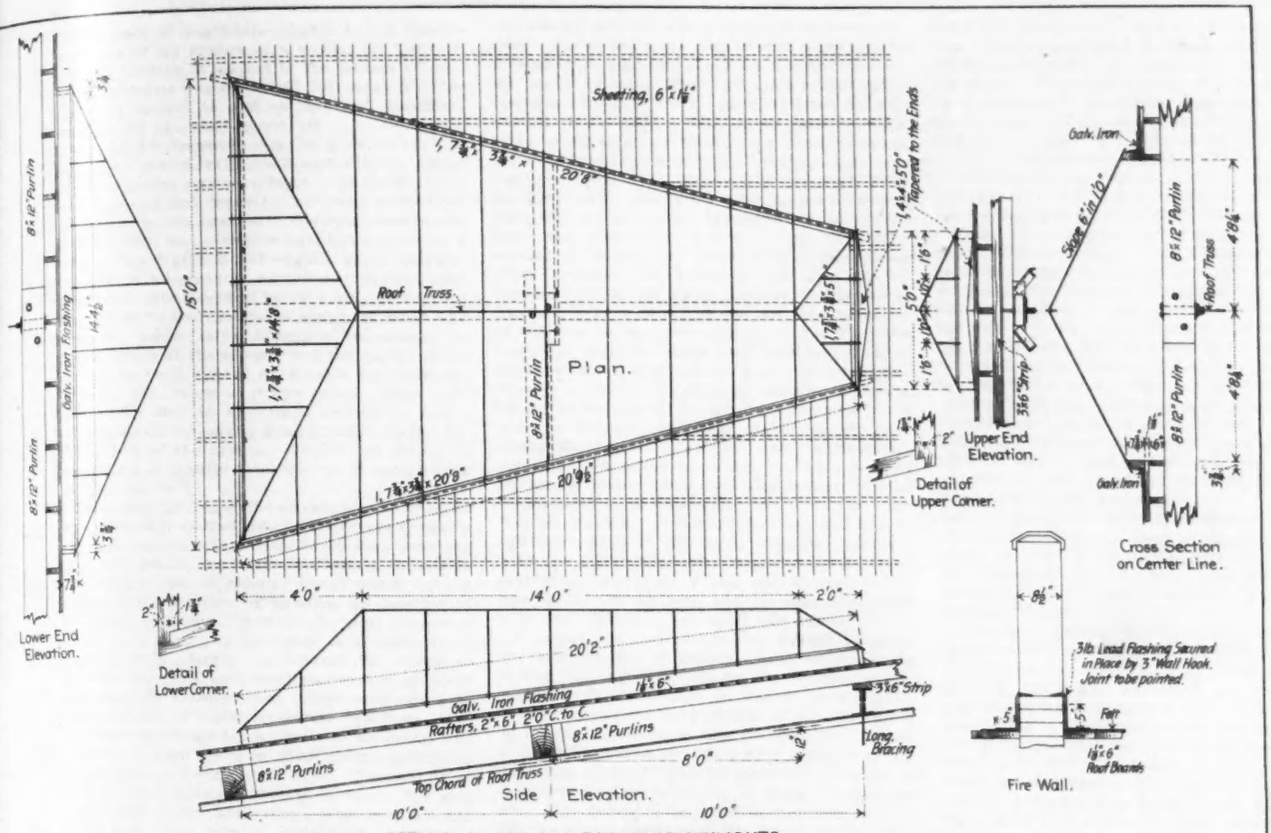


FIG. 22. DETAILS OF FRAMING FOR ROOF SKYLIGHTS.

FIG. 29. TRACK AND FLOOR CONSTRUCTION, FREIGHT CAR REPAIR SHOP.

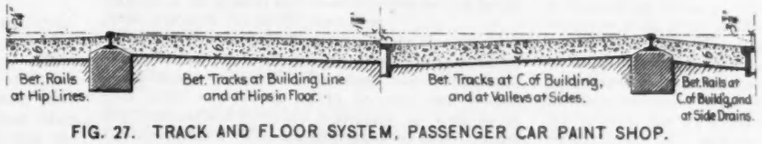
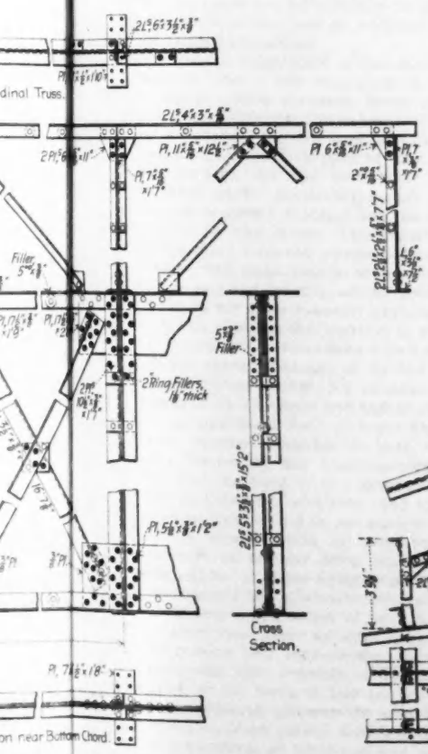

Bet. Rails at Hip Lines.
Bet. Tracks at Building Line and at Hips in Floor.
Bet. Tracks at C. of Building, and at Valleys at Sides.
Bet. Rails at C. of Building and at Side Drains.

FIG. 27. TRACK AND FLOOR SYSTEM, PASSENGER CAR PAINT SHOP.

FIG. 25. TRACK AND FLOOR CONSTRUCTION, PASSENGER CAR REPAIR SHOP.



ITUDINAL CENTER TRUSS.

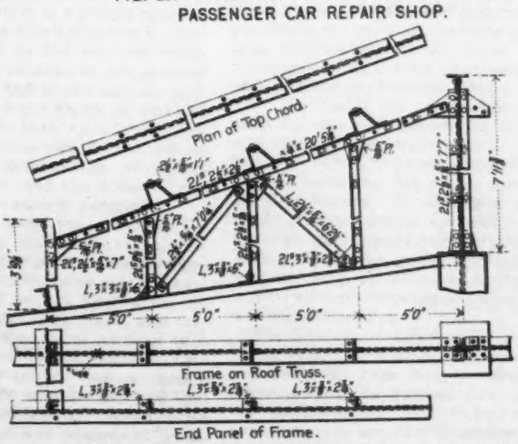


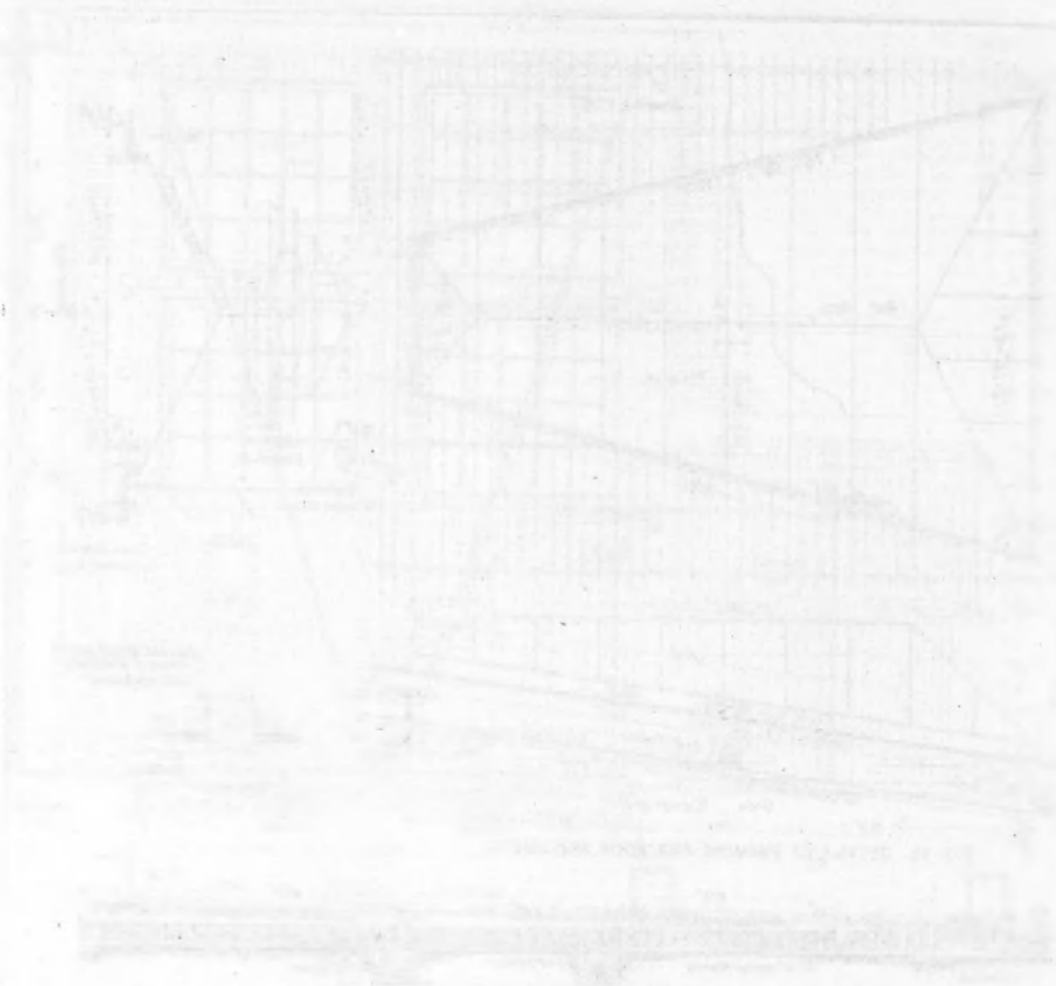
FIG. 21. DETAILS OF FRAMING FOR LANTERN SKYLIGHT.

GENERAL SHOPS
ILLINOIS CENTRAL R. R.,
BURNSIDE, ILL.

John F. Wallace, M. Am. Soc. C. E.,
Chief Engineer Illinois Central R. R.

H. W. Parkhurst,
Engineer Bridges and Buildings,
Illinois Central R. R.

CHAS. HART & SONS, LITH., 90 VESEY ST., N. Y.



Convenience of location in respect to the accommodation of the system as a whole; (2) Convenience of location in respect to the centers of supply of material and labor; (3) Advantages of location in respect to cost of land and buildings, facilities for extension, taxes, etc.

The relative importance to be given to each of the above considerations will evidently be different for almost every railway. If traffic were equally dense and important on every part of the system, a central location of the shop plant would theoretically, accommodate best the system as a whole. But traffic is not equally dense and important on all parts of hardly any railway system. Moreover a central location may be very inconvenient to the centers of supply of labor and material. Again, in the infancy of the system the headquarters of the officials and the earlier shops may have been located at a point far from the center of the system as it now exists. These considerations may be important enough to determine the location of the general shops at the extreme end of the system, even to the extent of compelling a greater expenditure in establishing division shops.

The consideration of the advantages of location with respect to cost of land and buildings, facilities for enlargement, etc., needs to be kept separate from the others, for there are certain factors in the construction of railway shops which remain constant irrespective of location as determined by other conditions. Perhaps the most important of these is space. Great space is a necessity in railway shop plants: (1) because the things to be handled—cars and locomotives—are of large size, and (2) because their weight and size prohibit the use of multiple storied buildings. Single story buildings are a practical necessity, and increase of floor space in them means absolutely an increase in their ground area. The bearing of this condition upon location is obvious. The shop plant must be situated where land is cheap and taxes low. This means, aside from exceptional cases, that the location must be outside of our larger cities. There may be cases, of course, where the railway company has ample space for shops within a large city, space secured when the city was young and land cheap, but this is not often the case. The area of high priced city land available to most railways is too valuable for freight yards and terminals to be given up to shop plants which can just as well and perhaps better be located elsewhere.

A case in illustration of this is the Illinois Central Ry., whose new shop plant we have been describing. This company holds property within the city of Chicago, the extent and value of which is exceeded by the city land held by few other railways. Until 1892, a part of this land had been occupied by car and locomotive shops, but increased traffic demanded larger terminals, and larger terminals required the use of the land occupied by the shops. The result was that the shops were removed outside of the city a dozen miles. The gain was a better location for the shops and the freedom of the land once occupied by them for more valuable purposes.

Let us consider this location in the light of some of the other considerations which have been mentioned above. Chicago is at the extreme limits of the Illinois Central Ry. system—at the extreme north of its southern line and at the extreme east of its westward line. General shops at Chicago were equally available to both lines. This city was, moreover, the headquarters of the official force of the road, it is a great center of supply for coal, lumber and iron, and the home of numerous men skilled in mechanical pursuits.

This consideration of questions affecting the location of railway shop plants might be prolonged, but it is our purpose here to discuss more particularly the principles governing the arrangement and construction of such a plant after the location has been decided upon. The best arrangement and construction to be adopted in a particular plant depends, of course, upon the character of the work it has to do, but a certain broad principle governs the arrangement and construction of all plants, and it is the concentration and grouping of buildings and equipment to secure a systematic and efficient division of labor. In a general repair shop for a railway there are two classes of work widely different in many respects, but at the same time having many points of similarity, viz.: the repair of locomotives and the repair of cars. There are also certain processes and kinds of work equally common to both classes. It is known that in locomotive work there are several processes, viz.: blacksmithing, boiler making, machine work, erecting, and several minor processes. Likewise in car work there are blacksmith work, wood work, carpentry, erecting, painting and minor processes. It is evident that the similarity between any two processes of locomotive work is generally closer than between the processes peculiar to locomotive work and those peculiar to car work. Further, it is evident that the different processes of boiler work are more closely related than the processes of boiler work and machine work in their entirety. Applying the broad principle stated above, the first point to be considered then is the differentiation of the various structures of the plant to suit the conditions of the various processes. The first broad differentiation is the grouping of the buildings, the second is the selection of the proportionate space and arrangement of the buildings in each group, and the third the interior arrangement of each individual building to suit the work to be done in it. Equally important with the above is the arrangement of the track system to furnish short and easy transport from one building to another, and an adequate provision for future extensions of the plant.

It is not the purpose here to discuss in detail the best method of grouping, and sub-grouping railway shop plants, because the conditions will require different forms in nearly every case. What it is wished to emphasize is the desirability of careful attention to this feature. The Illinois Central Ry. shops furnish a good example of this attention to the division of labor and grouping of buildings and are deserving of study for that reason. The points to be noted particularly are: (1) The separate grouping of the car shops and locomotive shops, with the buildings common to both between them and equally available to either; (2) in each group the location of the buildings between which communication is most frequent nearest to each other, and the provision of special facilities for transport; (3) the adoption of systematic provisions for transportation, sewerage, water supply, fire protection, lighting, etc., so as to concentrate the power machinery and collateral apparatus and to economize in the labor force required for their operation.

Turning to the individual buildings for railway shop plants, there are several requirements to be considered in their construction. Such construction must be chosen as to develop and utilize the best abilities of the workmen as well as of the machinery. The requirements to this end are ample floor area, the avoidance of unproductive travel and of floor spaces not open to immediate observation, abundant and uniform lighting, efficient heating and good ventilation and sanitation. As railway shops must of necessity be single story buildings, ample floor area is to be secured only by buildings of great lateral dimensions. This gives the best possible conditions for abundant and uniform lighting and good drainange and ventilation, but not so good conditions for easy heating nor for overlooking the workmen and avoiding unproductive travel.

By the liberal use of skylights a single story shop can be made almost as light as outdoors and there is little limitation to the use of such lights up to half the area of the roofs with the use of wire glass and the proper construction of the skylight frames. By making a portion of these lights movable, ample ventilation is secured. The questions of drainage and sanitation are also simplified. With the proper gratings, catch basins and crowning, the floors can be flushed clean with a hose and all drippings of grease and water adequately disposed of.

The difficulty of easy heating makes it a feature to be looked after only the more carefully. It is too often the case that the difficulty is met in railway shops by burning more coal rather than by installing an efficient heating system. Not many months ago in a discussion before a prominent railway club a well known superintendent of motive power made the statement that he did not think there was a shop on his system which was economically heated. Crude appliances installed and added to in a haphazard manner were the cause. Many other roads are suffering in the same manner. In the thoroughness of their heating system the Burnside shops of the Illinois Central R. R. stand as a monument of good sense and good engineering among railway shop plants in this country, as well as in their lighting, their drainage, and their other appliances for providing for the sanitary needs of the working force.

These points are mentioned here not alone because of their humanitarian desirability but because experience has shown that they mean again in dollars and cents by furnishing the best conditions for effective and rapid work. Take an illustration: it may seem of little moment whether the floors of the pits in a round house are crowned or dished as far as efficient drainage alone is concerned, but a man works dry shod in one and slops around and wastes time in keeping out of the water in the other. So it is often with other details of construction, but further than this, the effect of a clean, well lighted, well ventilated, well sewered and generally comfortable shop on the health, habits and disposition of the workmen can but be wholesome. This is a thing which has been learned by our most progressive manufacturers, many of whom go to almost excessive lengths in this direction, but a too small number of railway managers give it their attention, if we may judge from their shops.

Another important feature of shop construction is the interior arrangement. The best modern practice inclines toward single floor shops with as few dividing walls and partitions as possible. The reason for this is threefold, the lighting is better, unproductive travel is reduced, and the workmen are directly under the eye of the foreman from every part of the building. Probably the maximum division allowable is the separation of distinctly different departments, and when on the same floor and unless for good reason privacy is necessary it is an open question whether separating partitions are advisable even to this extent. The machine shop of the Burnside plant is open from one end of the building to the other. Even the office of the superintendent and foreman is a polygonal cabin with windows on all sides so that it affords a conning tower from which all points of the shop are visible. In railway shops the convenient obscurities of cars and locomotives are frequent enough temptations to loitering workmen without taking trouble to provide them in the shape of partitions, even if such construction was not objectionable for other reasons. It may seem to some that disproportionate stress is laid upon the interior arrangement of the shop in its relation to securing the best abilities of the men, but we believe that the experience of the best shop construction and practice will testify to the importance of this feature. The output of a shop is directly dependent upon the alertness, vigor and attention to duty of the workmen, and anything that acts to keep these faculties at the highest point acts to increase production.

Little has been said thus far about the purely structural features of the building construction in railway shop plants. Generally these are simple. The large area of roof and the provision for shafting, traveling crane tracks, and supports for hoists and suspended machinery are about the only things which introduce complexity. In the ordinary railway shop building the roof trussing is simplified and lightened by the frequent use of interior columns, which are also necessary for the support of the crane tracks and overhead machinery. Heavy hoisting and conveying machinery in the shape of bridge cranes, air and steam hoists, etc., is almost a necessary requisite of the locomotive shops and adequate provision should be made for them in constructing the framework, even though their use may be a thing of the future. At no other time will the task be so easy and inexpensive as during the first construction.

Architectural embellishment is a feature for minor consideration, although effort should always be directed to secure a neat and substantial appearance of the buildings. Uniformity in the spacing and construction of doors and windows and the lines of the brick walls does a great deal in this direction, and is moreover a measure of economy in construction.

It is recognized that little has been said in the foregoing which is not already known, but young engineers are constantly coming up who are not familiar with all these considerations and sometimes older men appear by their work to have forgotten them. It does not seem time and space idly spent, therefore, to emphasize the principles of railway shop construction in connection with the practical example of such work to which we have given so much space.

LETTERS TO THE EDITOR.

Proposed Standard Specification for Portland Cement.—Correction.

Sir: Referring to my article published in your issue of July 16, I would like to correct one error on the last column of p. 35, where it says: "Quick setting, final set to be not less than 30 minutes." It should read, "Quick setting, final set to be not over 30 minutes." This was a typographical error in the pamphlet which I got up, and which I did not notice until my attention was called to it a few days ago. There are no other errors in the article. Yours very truly,

Wm. J. Donaldson.

Betz Building, Philadelphia, Pa., July 21, 1896.

A Confusion in Titles.

Sir: The following incident is brought to mind by the recent meeting of the Christian Endeavor Society at Washington: A member of the engineering corps of a prominent steel manufacturing concern, desiring to purchase a certain book on the subject of his profession, had his office boy go the rounds of all the leading book stores of the city for the purpose of procuring a copy, but without success, until finally the youth brought up at the United Presbyterian Book Store. Upon afterwards being asked what reason he had for inquiring at a store in which technical books are not ordinarily kept in stock, he replied that he thought they must have it for he saw a sign in the window which read, "C. E. Supplies."

J. C.

Pittsburg, Pa., July 17, 1896.

Dangerous Reference Points.—A Warning.

Sir: The enclosed pieces of steel tape were melted to-day by an electric current. In referencing a street monument from an iron trolley pole, the tape touched the rail and was melted at the point of contact. The end against the pole was also melted and the assistant's thumb and forefinger were severely burned.

The superintendent of the electric railway was notified and sent men at once to investigate the cause of the grounding of the current. Yours truly,

A. J. Gavett.

Plainfield, N. J., June 22, 1896.

(The accompanying sketch was drawn from the pieces of tape sent by Mr. Gavett. The pieces are

STEEL TAPE MELTED BY ACCIDENTALLY TOUCHING TROLLEY RAIL WHILE BEING HELD AGAINST IRON TROLLEY POLE.

blued over part of their length and show marked evidences of the extreme heat to which they were subjected.—Ed.)

A Neglected Formula in Trigonometry.

Sir:—The following formula, applicable to the three sides and one angle of a plane triangle:

$$c^2 = a^2 + b^2 - 2ab \cos C \qquad (1)$$

or,

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab} \qquad (2)$$

(in which a, b, and c are the lengths of the sides and C the angle opposite side c) is familiar to the student of applied mechanics on account of its use with the parallelogram of forces, or of velocities. In case a, b, and c are given and C is the quantity sought, it would seem to be the most convenient formula to use, instead of the indirect relation necessitating the preliminary determination of the sum of the three sides and the difference between that sum and each of the sides, with the result that only the half angle is found, instead of the whole angle.

It is a matter of some surprise, therefore, that this formula, (1), is not to be found in engineers' pocket-books published in the United States, although given in foreign publications (for example in Weisbach's "Ingenieurs Taschenbuch" and in "Huette").

Only a few months ago a gentleman on the Pacific coast, in a letter to the writer, stated a modified form of formula (1) as original with himself, and inquired if it was not new, since he had been unable to find it in Haswell's Pocket-Book, and thought it simpler than those given in that work. It seems worth while, then, to call attention to the formula in your columns.

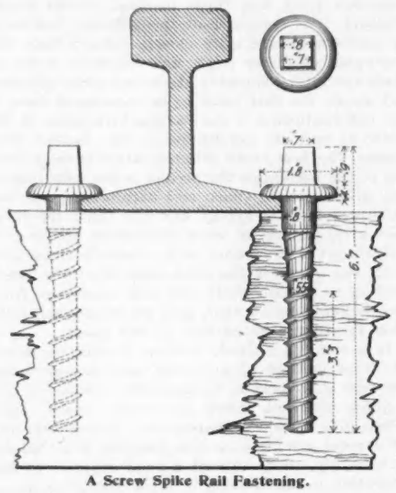
Sincerely yours, I. P. Church.

Ithaca, N. Y., July 4, 1896.

The Need of Improvement in Rail Fastenings.

Sir: The information on the present standards of American railroad tracks, contained in the articles and tables given in your issue of June 25, is not only interesting but of great value, and you deserve the thanks of all concerned with railroad construction and maintenance.

I strongly sympathize with your opinion as to the very unsatisfactory character of the ordinary spike as a rail fastening. To one who has observed with any care the



A Screw Spike Rail Fastening.

condition of the track on even our best lines and noted the fact that hardly more than one-third of the spikes are effective to hold the rails down to the tie, or to do more than to keep them from moving sideways, nothing is more surprising than the continued use of such spikes. In this respect our railways are far behind those of Europe. Either the English bolt and treenail, used with their chairs and double-headed rails, or the Continental screw spike, used with the flat-footed rails like ours, is far better. The latter, the screw spike, is worthy of our special attention. For while it would cost somewhat more at first, it is more durable, as it can be drawn and replaced or used over again without injury to either the spike or the tie, and has the further capital advantage of having a holding power at least double that of the common spike. Its use would save many rail braces, and many ties which are now spoiled by old spike holes. Being unpatented and unpatentable it cannot command the services of enterprising agents to urge its introduction, but even without this, its great merits ought to secure its adoption on all first-class railways.

To make more clear the special features of the screw spike I enclose a blue print of a design, made several years ago, which follows very closely that of the spikes in common use on the Continent—particularly in France.

Robert Moore.

Room 52, Laclede Building,
St. Louis, Mo., July 2, 1896.

A Novel Scheme for Power Transmission.

Sir: I have recently devised a very novel system for the transmission of large amounts of power over long distances, which seems to me to have much merit. The system I propose is hydraulic transmission under very high pressure, say 5,000 lbs. per sq. in. Under this pressure it will be readily understood that a very small amount of water will transmit a large amount of power. The difficulty has been, however, that if such water is carried in metal pipes, they must be very thick and costly to withstand the enormous pressures, and as the system only becomes economical compared with electrical transmission when large conduits are used, the use of metal pipes is not feasible. Now, what I propose is to build a tunnel in solid rock for conveying water under high pressure, make it water tight by putting in a continuous lining of metal of moderate thickness, and rely for strength entirely on the solid rock in which the tunnel is built.

To show an application of this system I have taken the transmission of power from Niagara Falls to New York as an example. Call the distance 320 miles. A 30-ft. cylindrical tunnel with water moving through it at 4 ft. per second would give a flow of 2,800 cu. ft. per second. At a pressure of 300 atmospheres this would furnish in round numbers 2,500,000 HP. The loss of pressure in the 320 miles at the low velocity above given would be only 3.3% Estimating the cost of such a tunnel at $80 per lineal foot, its total cost would be about $100,000,000, and with 10% of this sum for interest and depreciation, the annual cost per 24-hour horse power would be only $4. One dollar per horse power per annum would pay for the hydraulic machinery required.

I have filed a caveat on the above system of power transmission. Very respectfully,

Charles Steiner.

403 Bushwick Av., Brooklyn, N. Y.,
July 14, 7896.

(Our correspondent evidently does not hesitate at large figures.—Ed.)

The Spread of Dry-Rot.

Sir: I would like to hear your opinion, or that of some readers of Engineering News, about the character of dry-rot as a defect in lumber. The Encyclopedia Brittanica, treating of this subject, says it is a disease "apparently of an infectious character." If this is true, it would appear that timber having a defect of this nature, in the least degree, is unsuited for use in any permanent structure; as it is only a matter of time before the entire body of such sticks, thus affected, will be reduced to the same condition.

The question which, at present, concerns me, is this: Will heavy beams or girders of Southern hard pine, when used for inside work and occupying a well-ventilated situation, deteriorate from a small patch of "dote" or dry-rot such as is frequently found in such timber, at the butt end, and which otherwise, or for present purposes, is thoroughly acceptable for its intended use?

I am satisfied similar lumber is constantly used in buildings, and if any of your readers have positive knowledge that lumber of this kind deteriorates more rapidly, under favorable conditions, than sticks not affected; or if such, after years of use, show no apparent spread of the decay, I should for one be glad to hear their testimony. A. F. W.

Centreville, R. I., July 8, 1896.

(We referred the above letter to the Division of Forestry, at Washington and have received the following reply:—Ed.)

Sir: In reply to your favor of the 11th instant, addressed to Mr. Fernow, who is absent on an extended tour through the West, permit me to say that the probability of dry rot spreading in beams of Southern hard pine when used for inside work in a well ventilated situation is very slight. As your correspondent is doubtless aware, dry rot is a form of fungus, being one of many different genera which grow in the inter-cellular spaces of timber, forming masses of extremely minute threads which penetrate in all directions, practically filling up the cell cavities and eating up, as it were, the cell walls, leaving a mass of dead and dried up threads of the wood material behind, after they are killed or have finished their work. At particular places thousands of these threads come to the surface and aggregate in a crack of the wood forming the whitish or colored bodies which we see as toadstool, bracket funges, etc. These are fruiting bodies which give rise to spores corresponding to the seed of higher plants. These fungi require quite an amount of moisture for their growth, especially at the start, and therefore well seasoned wood is not attacked, and they can even be killed, and usually are, and the "dotage" stopped by drying the timber thoroughly, preferably submitting it to a dry kiln treatment, where the heat will not only kill the fungi and spores but the seasoning will prevent further attacks.

There is little doubt that doty spots are easier of attack and, therefore, endanger the timber to some extent, but if well dried and placed in a dry, well ventilated position, the progress will stop.

Trusting that these notes will be of interest to you, I am, Yours respectfully Charles A. Keffer,

Acting Chief, Division of Forestry.

Washington, D. C., July 13, 1896.

The Advantages and Disadvantages of a Steam Pile-Driving Hammer.

Sir: I have had occasion recently to use one of the Vulcan Iron Works steam pile driving hammers on the work under progress at the foot of Perry St., North River, N. Y., for the Department of Docks, and my observation of its use and progress in the cheapening of the cost of labor in driving through hard material, as compared with the drop hammer, is such that I feel confident it is only a question of time when, for specific cases, with a few improvements which can readily be made, a steam hammer will become universal, if the prejudices and fear of handling one can be overcome by those who are willing to try it and be benefited thereby.

The driving in the above locality is very hard, the bottom consisting of a 10-ft. layer of cobble stones, the

largest being 6 ins. diameter, from 20 to 30 ft. below mean low water, and below that layers of very fine sand, coarse gravel and sand gravel alternate until rock or boulder is reached at a depth of about 90 ft. below mean low water, as shown by test borings.

With the drop hammer 12 piles, 9 in a row, from 2 ft. 3 ins. to 3 ft. c. to c., was considered a very good day's work (of 10 hours) with a crew of ten men. The pile dimensions averaged as follows: point 8 ins., butt 16 ins., length 55 ft. to 60 ft., and took an average of about 175 blows of a 3,300-lb. hammer falling 10 ft. Fifteen blows to the minute was a good average when working, the piles penetrating to from 43 to 50 ft. below mean low water.

With a Vulcan hammer of 8,400 lbs., the piston weighing 4,000 lbs. and having a 42-in. stroke, we were enabled to drive at the rate of 18 piles a day, two rows, and regulate and stay lathe them, the hammer striking 60 blows to the minute and some of the piles taking over 1,200 blows, without a sign of the head being broomed.

The steam hammer can be worked with from two to three less men in a crew than the drop hammer. The principal faults noticeable are that it is almost impossible and certainly not practical with economy to drive crooked piles, and that there is a great tendency to lose overboard the "saucepan" or hood which fits over the head of the pile when it has been trimmed to fit the hammer, which also wears out very quickly. A delay of from 2 to 5 minutes was caused by the steam condensing in the hose pipe leading to the hammer when it was hoisted aloft, a "U" being formed, but this is only a mechanical defect which can easily be remedied. After a pile is once placed, headlines can be dispensed with and the pile is more rapidly and truly driven to place than with the drop hammer. The use of this hammer by the Department of Docks was experimental and had to be stopped after about 75 piles had been driven owing to the fact that the "saucepans," of which there were only two, had worn out. Yours truly,

Eugene Lentilhon,
Assoc. M. Am. Soc. C. E.

New York, July 20, 1896.

The Cubic Parabola as a Transition Curve for Street Railways.

Sir:—While engaged in business in Pittsburg, Pa., last year I had occasion to establish the alinement of an electric railway, and found in the cubic parabola an easy solution to a seemingly difficult problem. An explanation

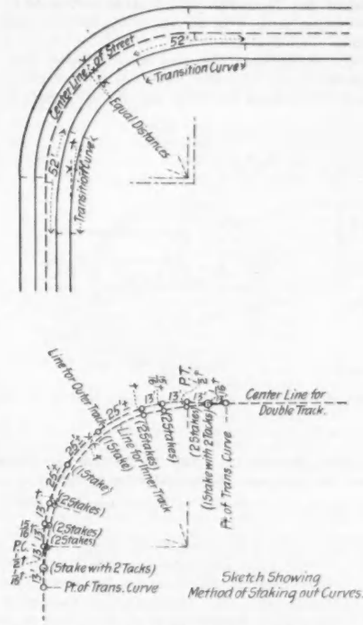
will be of interest and possibly of benefit to some of your readers.

The city of Allegheny straightened, widened, graded and paved Perryville Ave., necessitating the complete rebuilding of the Pleasant Valley Ry. Co.'s line on that street. The avenue is a long and important thoroughfare; as it runs in many places along steep hillsides, requiring heavy retaining walls on both sides, its width was restricted to 60 ft., and at the southern end to 50 ft.; 32% of the alinement is curved; the total curvature amounting to about 1,600°. The radii of curves vary from 50 to 573 ft. In view of the narrowness of the street and the large amount of travel over it, the City Engineer fixed the distance between centers of tracks on tangents at 8 ft. 6½ ins., leaving a clearance of only 6¼ ins. between cars, but allowing the tracks to be spread sufficiently on curves to give the same clearance, but no more; requiring, however, that the tracks should follow approximately the line of the street and that a nearly equal distance should be maintained between track and curb on both sides.

The largest cars in use on this line are 30 ft. long over all; length of car body 22 ft.; maximum width 8 ft. 0¼ in. The cars are mounted on single trucks, with a wheelbase of 8 ft.

It is evident that no arrangement of simple curves would allow the cars to pass at the P. C.'s and P. T.'s and that any arrangement of compound curves would either make too much difference between the alinement of street and track, or would greatly complicate calculation and field work and add to the perplexities of the track foremen. I used the following comparatively simple method to fulfil the complex conditions:

The tracks were made concentric, being spread sufficiently to allow for the "overhang" of the cars; the outer track was made a simple curve, but a cubic parabola was introduced at each end of the inner track; the P. C. and P. T. of the outer track were moved toward the P. I. from the P. C. and P. T. of the street alinement, enough to



make the two tracks equidistant from the center of the street at the middle of the curve.

Approximately $t = \frac{l^2}{8R}$, t being the distance the tracks are spread, or the offset of the inner track, from the tangent to the regular curve produced; l the length of the car, and R the radius of curvature. I took l = 30 in order to "steal" a factor of safety, although l = 22 would have been theoretically correct, as the platforms of the cars are much narrower than the car bodies.

For the length of the cubic parabola (L)

$$\frac{3t}{\frac{1}{2}L} = \frac{\frac{1}{2}L}{R} \text{ or } L = \sqrt{24\,t\,R} \text{ (approximately)}$$

or $L = l\sqrt{3}$, a constant for all radii.

Substituting l = 30, L becomes 51.96. Using l = 22, L would become 38.10.

I staked out the outer curve, using two chords of 13 ft. at each end, and dividing the rest of the curve in equal chords of as nearly 25 ft. as possible, for the convenience of the trackmen. Two stakes at 13 ft. and 26 ft. from tangent point, were also put in on tangent. Additional stakes were set by offsets from both tangent and curve for the parabolic portion of the inner curve, but no stakes were necessary for the circular portion.

The trackmen found no difficulty, after the first trial, in bending the rails to a parabolic curve; they began with the sharper end of the curve, with the bender set the same as for the regular curve, and loosened the screw each time the position of the bender was shifted.

To determine the minimum clearance between cars on any curve, and the extent to which this solution is applicable, let

a = distance from end of car body to axle,
b = distance between axles,
s = distance from pt. of trans. curve to nearest axle,
z = offset of end of car body from position on tangent,
x = offset of first axle from tangent,
x^1 = offset of second axle from tangent,
k = a constant, depending on nature of cubic parabola.

Then $x = ks^3$

and $x^1 = k(s+b)^3$

and $z = \frac{a}{b}(x^1 - x) - x$

or $z = \frac{a}{b}x^1 - \frac{a+b}{b}x$; substituting values for x and x^1,

$$z = k\left[\frac{a}{b}(s+b)^3 - \frac{a+b}{b}s^3\right]$$

or $z = k(3as^2 + 3abs + ab^2 - s^3)$.

To find a maximum value of z

$$\frac{dz}{ds} = k$$

or $s = a + \sqrt{a(a+b)}$

and $z = k\left[(a^2 + ab)(2a + b + 2\sqrt{a^2+ab})\right] =$

$$ka(a+b)(\sqrt{a} + \sqrt{a+b})^2$$

but $k = \frac{x}{s^3} = \frac{4t}{L^3}$

hence $z = \frac{4t}{L^3}a(a+b)(\sqrt{a} + \sqrt{a+b})^2$

and for L = 51.96, a = 7, b = 8, z = 0.127t or $\frac{7.6835}{R}$

the clearance of tangent being 6¼ ins. = 0.52 ft.

the minimum clearance is $0.52 - 0.127\,t$, or $0.52 - \frac{7.6835}{R}$

Substituting 0.52 for z, we get R = 14.77, the smallest radius to which this solution could be applied. As the minimum radius on this line was 50 ft., the solution was therefore applicable in every case. Yours truly,

Jenks B. Jenkins, C. E.

New York city, June 11, 1896.

Notes and Queries.

R. S. M. asks which is the better practice in lettering maps, to say "Scale: 500 ft. = 1 in.," or "Scale: 1 in. = 500 ft.?" So far as we are aware the former expression is more commonly used on maps and the latter on drawings of structures, machines, etc., especially detail drawings to a large scale. Still another way to designate a scale, and one which has much to commend it, is to say "Scale = $\frac{1}{500}$."

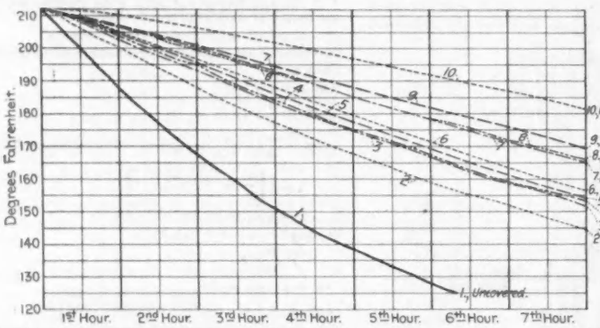
R. W. W., Shreveport, La., asks which side up an oak tie should be laid, which has one side flat for its full width and the other side has its corners rounded off. The roadbed is dirt. We refer the query to our readers.

WEATHER TABLE FOR JUNE, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—rain or melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	59.9	86	36	50	8 8	36	NW	1.62	.81	8
	Portland, Me.	62.6	90	47	43	7.5	27	S	2.23	.60	10
	New York City.	66.5	87	51	36	10.9	40	NW	6.38	2.59	11
	Pittsburg, Pa.	70.4	89	47	42	4.9	24	SW	4.79	1.22	15
	Chicago, Ill.	66.8	89	50	39	14.2	50	SW	2.82	.92	12
	Omaha, Neb.	72.0	94	49	45	7.3	35	NW	1.90	.69	10
	St. Paul, Minn.	68.2	89	47	42	6.5	32	NW	3.30	1.59	9
	Duluth, Minn.	61.0	90	39	51	9.1	42	NE	2 00	.63	11
	Bismarck, N. Dak.	65.6	96	42	54	10.3	47	SW	2.64	1.30	11
	Average.	63.7	90	45	45	8.8	37		3.08	1.15	11
Southern Cities.	Washington, D. C.	71.3	92	52	40	5.2	26	NW	2.39	.72	13
	Louisville, Ky.	74.2	92	56	36	6.7	32	W	4.79	2.87	10
	St. Louis, Mo.	74.0	91	56	35	8.2	52	NW	4.57	.72	15
	Savannah, Ga.	79.6	99	64	35	6.5	27	NE	5.31	1.25	15
	Kansas City, Mo.	72.2	92	50	42	6 5	32	NW	2.04	.59	11
	Jacksonville, Fla.	80.0	97	66	31	7.1	32	S	9.41	3.07	14
	Chattanooga, Tenn.	75.0	94	56	38	6.6	33	NW	2.64	0.85	6
	New Orleans, La.	80.0	95	69	26	7.1	30	SE	8.23	2.02	17
	Memphis, Tenn.	77.0	92	58	34	7.9	39	W	2 07	0.49	9
	Palestine, Tex.	81.6	100	58	42	5.9	20	N	0.71	0.60	5
	Average.	76 5	94	58	36	6.7	32		4 22	1.32	12
Western Cities.	Helena, Mont.	63.2	88	39	49	8.0	36	SW	0.71	.25	8
	Port Angeles, Wash.	53.8	83	40	43	7.3	27	SW	0 31	.08	6
	San Francisco, Cal.	57.2	79	47	32	14.3	42	W	.00	0	0
	Salt Lake City, Utah.	70 0	93	44	49	6.2	30	S	0.25	.23	2
	Santa Fe, N. Mex.	69.0	89	48	41	7.4	31	SW	0.69	.49	4
	Denver, Colo.	68.2	92	44	48	7.3	36	NE	0.89	.25	9
	Yuma, Ariz.	88.8	117	63	54	6.7	32	SW	.00	0	0
	Average.	67.2	92	46	45	8.2	33		0.41	0.19	4

TESTS OF NON-CONDUCTING MATERIALS FOR BOILER COVERINGS.

The Canadian Pacific Ry. Co., in April last, undertook a series of experiments to determine the comparative merits of various different coverings for steam boilers, to determine which was the best to adopt as a lagging for the boilers of its locomotives. Among the materials tested was a new composition made by the Mica Boiler Covering Co., of Toronto, Ont., which showed in the test remarkable insulating qualities, materially exceeding those of any other non-conductor tested, as will be seen by the lines on the accompanying diagram.



EXPERIMENTS TO DETERMINE RELATIVE HEAT INSULATING POWER OF VARIOUS BOILER COVERINGS.
Made at the Canadian Pacific Ry. Shops, April, 1896, R. Atkinson, Mechanical Superintendent.

Note: In all the tests but Nos. 9 and 10, to the covering noted above an outer coat of Russia iron was added.

The method of testing was as follows: An iron tank was entirely covered with the non-conductor to be tested, and was then filled with water which was heated to a temperature of 212°. The tank was then allowed to cool and the temperature of the water in its interior was taken at intervals, and the diagram was constructed in accordance with these results. Simultaneous observations were taken of a thermometer in the room where the tank was located, and these results were also plotted, but as they showed the atmospheric variations to be too small to have any appreciable effect on the results we do not reproduce this diagram, merely remarking that these external temperatures varied between extremes of 70½° and 87°, out in most of the tests the range was much smaller than this.

The tank used in tests 1 and 2 was 14 ins. high and 13⅜ ins. in diameter. That used in tests 3, 4 and 5 was of the same diameter and 15¼ ins. high. That used in tests 6, 7, 8, 9 and 10 was 13⅜ ins. diameter and 13⅝ ins. high. While the tests should properly have all been made with the same tank, the difference in size does not appear to have been great enough to materially affect the results.

The fact above stated and the diagram from which ours is redrawn are published in the "Canadian Electrical News," which presents also the following table, showing the loss of heat in degrees in the fifth hour per degree of difference of temperature between the tank and the surrounding atmosphere:

Covering.	Mean temp. during 5th hr.	Diff. bet. tank and air, deg.	Loss, Actual, deg.	5th hr. Diff. of temp., deg.
None	133½	55½	11	0.198
Asbestos composition	163½	85½	9	.105
Sectional magnesia	181¾	103¾	7	.0674
Wood lagging and air space	181¾	103¾	7	.0674
Asbestos and wood	185	107	6	.056
Mica	194½	116½	5	.0428

It will be seen from the above that the heat escaping from the bare tank was 1.88 times that escaping through the asbestos compounds, 2.92 times that lost through the sectional magnesia blocks, or the wood lagging and air space, 3.53 times the loss through the asbestos and wood covering, and 4.62 times the loss through the mica covering.

The mica covering has been placed upon the market quite recently, and, we are informed, consists of leaves or films of mica separated by minute corrugations so as to make a great number of air cells. Any of our readers interested can doubtless obtain samples by addressing the manufacturers, the Mica Boiler Covering Co., 9 Jordan St., Toronto.

THE EFFECT OF RETARDERS IN FIRE TUBES OF STEAM BOILERS.*

By Jay M. Whitham,** M. Am. Soc. M. E.

The trials were conducted on a 100-HP. horizontal tubular boiler at the Sutherland Ave. Station of the Philadelphia Traction Co., Philadelphia. The purpose of the trials was to ascertain under what condition, if any, retarders in the fire tubes would add to the efficiency of the boiler.

Dimensions and Proportions of Boilers and Setting.

Boiler shell ..... 60 ins. × 20 ft.
Tubes (44) ..... 4 ins. × 20 ft.
Grate surface ..... 26.7 sq. ft.
Water-heating surface ..... 1,137 sq. ft.
Ratio of heating surface to grate area ..... 42.6 to 1
Steam-drying surface in top of shell ..... 150 sq. ft.

Boiler set with a return pass over the top.

Ten such boilers are connected to a brick stack 10 ft. diameter by 175 ft. high. During the tests from four to seven of these boilers were run in connection with the boiler tested. On certain tests retarders were used in the tubes. These were made of loosely fitting strips of No. 10 sheet-iron, running the whole length of the tubes, and twisted to a pitch of 10 feet., or making two entire convolutions in the length of the tube.

The tests were conducted according to the methods advised by this Society, and all instruments used were standardized. L. Kennedy, a careful and skilful fireman, fired on all the tests. The boiler tubes were clean at the beginning of each test, while the boiler was fairly clean on the water side. Several of the tests were duplicated in order to make sure that no error existed.

Results of the Trial.

Coal.—The coal was practically uniform in quality on all the tests. The percentage of ash and refuse varied from 8.72 to 4.25%.

Drafts.—The draft was measured in the furnace, in the front connection, and in front of the damper at the rear end of the return pass over the top of the boiler. The damper was manipulated so that the draft would be just sufficient to burn coal for the power desired to be developed on each test.

Table I. compiled from the results obtained in the tests should be valuable in predicting the drafts needed for any rate of combustion from 5 to 40 lbs., an hour per sq. ft. of grate with bituminous coal, natural draft and horizontal tubular boilers, while it should be of use also with water-tube boilers.

TABLE I.—Draft Required for Boiler with Various Rates of Combustion.

Pounds of dry coal burned per hour per sq. ft. of grate.	Resistance due to ——Total draft—— Furnace draft.	Pass under boilers and thro' tubes; no retarders.	Retarders in tubes.	Pass over top of boilers.	No. retarders; no return pass.	With retarders; no return pass.	Top pass; no retarders.	With top pass and retarders.
	inch.	inch.	inch.	inch.	inch.	inch.	inch.	inch.
5	0.04	0.04	....	0.04	0.08	0.08	0.12	0.12
8	0.11	0.05	0.02	0.04	0.16	0.18	0.20	0.22
10	0.13	0.07	0.03	0.05	0.20	0.23	0.25	0.28
12	0.17	0.07	0.04	0.05	0.24	0.28	0.29	0.33
14	0.19	0.10	0.03	0.05	0.29	0.32	0.34	0.37
15	0.20	0.11	0.03	0.05	0.31	0.34	0.36	0.39
16	0.21	0.12	0.03	0.05	0.33	0.36	0.38	0.41
18	0.23	0.13	0.06	0.05	0.36	0.42	0.42	0.48
20	0.24	0.16	0.08	0.06	0.40	0.48	0.46	0.54
22	0.26	0.18	0.12	0.06	0.44	0.56	0.50	0.62
25	0.27	0.22	0.19	0.06	0.49	0.68	0.55	0.74
28	0.29	0.24	0.27	0.07	0.53	0.80	0.60	0.87
30	0.30	0.27	0.31	0.07	0.53	0.88	0.64	0.95
34	0.32	0.31	0.38	0.08	0.63	1.01	0.71	1.09
36	0.33	0.34	0.40	0.08	0.67	1.07	0.75	1.15
40	0.36	0.38	0.46	0.08	0.74	1.20	0.82	1.28

Quality of Steam.—The steam was practically dry for every condition of the tests, however much, the boiler was pushed in capacity. This is due to the large liberating surface in boiler and the use of dry pipes.

Economic Evaporation.—Table II. shows tests with and without the use of retarders.

The advantage due to retarders is as high as 18% when the boiler is greatly forced. The temperature of the waste gases is always less when retarders were used. Herein lies the advantage of retarders. Their use renders more efficient the heating surface of the tubes, enabling the gases to be reduced in temperature, and the same capacity of boiler to be developed with a less expenditure of fuel.

The accompanying cut shows at a glance the usefulness of retarders. A reduction in temperature of the waste gases shows at once a decrease in the coal consumption, as follows:

52	HP., gases reduced	20°	F., fuel saving	0.0%
75	" "	53°	" "	0.0%
100	" "	22°	" "	3.2%
125	" "	46°	" "	4.0%
150	" "	19°	" "	3.3%
170	" "	59°	" "	3.6%
200	" "	36°	" "	4.1%
225	" "	26°	" "	8.6%
239	" "	123°	" "	18.4%

Variation of Economy with Capacity.—By Table II. we see that the 100 HP. boiler, rated on 11.37 sq. ft. of water-heating surface to the horse-power, could easily develop over 200 HP. At its rated power 3.03 lbs. of water, from and at 212° F., were evaported per hour, yet there was no difficulty in evaporating 7.26 lbs. to 1 sq. ft., or in getting a horse-power on 4.76 sq. ft. of heating surface.

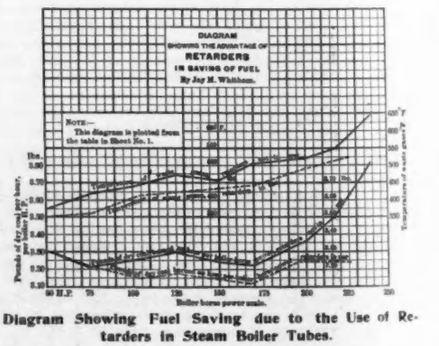


Diagram Showing Fuel Saving due to the Use of Retarders in Steam Boiler Tubes.

TABLE II.—Results of a Series of Trials on a 100-HP. Horizontal Tubular Boiler, to Determine the Value of Retarders in the Tubes.

Duration of trial, hours	9	9	9	9	9	9	9	9	9.1	9	9	9	9	9	9	9	9	9
With or without retarders in tubes	W'out	With.	W'out	With.	W'out	With.	W'out	With.	W'out.	With.	W'out	With.	W'out	With.	W'out	With.	W'out	W'out.
Absolute steam pressure in boiler, lbs.	135.20	132.16	135.45	133.35	137.17	134.90	138.30	133.90	136.70	132.80	136.23	133.52	136.90	133.56	136.50	133.53	135.66	
Draft in pass over boiler at damper, ins.	0.16	0.15	0.21	0.28	0.33	0.31	0.36	0.38	0.42	0.49	0.51	0.53	0.65	0.71	0.62	0.86	0.67	
Draft in furnace over top of fire, ins.	0.07	0.07	0.13	0.13	0.17	0.17	0.19	0.20	0.24	0.23	0.25	0.24	0.36	0.24	0.30	0.34	0.32	
Temperature of fire room, degrees F.	103	70	94	67	104	70	112	75	110	76	87	76	102	78	99	80	89	
Temperature of escaping gases, degrees F.	371	351	414	361	444	412	470	424	455	436	506	447	526	490	551	523	646	
Percentage of ash and refuse in dry coal, %	8.33	8.72	6.04	7.42	6.15	5.55	4.93	5.81	4.93	5.06	4.96	5.76	4.63	5.49	4.43	4.53	4.25	
Quality of steam, dry steam taken as unity	0.99	0.99	0.99	0.99	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.00	0.99	
Water evap.,* per lb. of dry coal, lbs.	10.43	10.44	10.70	10.72	10.58	10.92	10.44	10.86	10.65	11.09	10.70	11.09	10.26	10.68	9.84	10.69	9.03	
Water evap.,* per lb. of combustible, lbs.	11.38	11.43	11.38	11.57	11.29	11.56	10.99	11.53	11.20	11.60	11.27	11.53	10.76	11.30	10.29	11.19	9.45	
Saving in dry coal by use of retarders, %					—3.22—		—4.02—		—3.29—		—3.55—		—4.09—		—8.64,	18.39—		
Water,* per hour per sq. ft. of heating surface, lbs.	1.59	1.59	2.25	2.34	3.03	3.16	3.80	3.87	4.55	4.51	5.25	5.13	6.06	5.99	6.59	6.86	7.26	
Dry coal burned per hr per sq. ft. grate surface, lbs.	6.49	6.49	8.89	9.33	1213	12.30	16.35	15.18	19.20	17.45	20.87	19.73	26.55	23.86	30.10	27.32	34.50	
Boiler HP., basis 34½ lbs. water, 212°F., pr hr., HP.	52.4	52.4	74.6	77.3	99.7	104.2	125.3	127.5	150.0	148.6	169.6	169.1	199.7	197.3	217.4	226.1	239.0	
Heating surface per HP. developed, sq. ft.	21.7	21.7	15.24	14.71	11.37	10.91	9.09	8.92	7.58	7.65	6.70	6.72	5.68	5.76	5.23	5.03	4.76	

*From and at 212° F.

* Condensed from a paper presented at the St. Louis meeting of the American Society of Mechanical Engineers.
** 131 South 3d St., Philadelphia, Pa.

The cost in fuel of a horse-power was as follows for the tests made without the use of retarders:

Boiler, HP.:
52.4 74.6 99.7 125.3 150.0 169.6 199.7 217.4 239.0

Dry coal per HP., lbs.:
3.30 3.21 3.25 3.30 3.24 3.22 3.36 3.51 3.82

These results show that there is practically no change in the economic workings of the boiler when run at from 50% below to 70% above its rating, i. e., when making a horse-power an hour on anywhere from 21.7 to 6.7 sq. ft. of heating surface.

The cost of fuel per horse-power was as follows for the tests made with retarders in the tubes:

Boiler, HP.:
52.4 77.3 104.2 127.5 148.6 169.1 197.3 226.1

Dry coal per HP., lbs.:
3.30 3.21 3.15 3.18 3.14 3.11 3.23 3.23

It is therefore evident that retarders enable a boiler to be run as economically on 5 sq. ft. of heating surface to the horse-power as on 21.7 sq. ft., or, practically, as on any number of square feet between these limits.

Conclusions.

1. Retarders in fire tubes of a boiler interpose a resistance varying with the rate of combustion.

2. Retarders result in reducing the temperature of the waste gases, and in increasing the effectiveness of the heating surface of the tubes.

3. Retarders show an economic advantage when the boiler is pushed, varying in the tests from 3 to 18%.

4. Retarders should not be used when boilers are run very gently, and when the stack draft is small.

5. It is probable that retarders can be used with advantage in plants using a fan or steam blast under the fire, or a strong natural or induced chimney draft, when burning either anthracite or bituminous coals.

6. Retarders may often prove to be as economical as are economizers, and will not, in general, interpose as much resistance to the draft.

7. Retarders can be used only with fire tubular boilers.

8. The economic results obtained on the boiler tested are ideal, showing that it was clean, the coal good in quality, and the firing skillful. With retarders the tubes are more effectively cleaned than without their use.

9. The tests prove that the marine practice of using retarders is good, and that the claim, often advanced, that they show from 5 to 10% advantage, holds, whenever the boiler plant is pushed and the draft is strong.

Discussion.

Charles Whiting Baker.—It is a rather curious fact that while "retarders," as they are called, have been used more or less for several years, and, in some instances with very notable advantage, Mr. Whitham's paper, so far as I am aware, is the first extended account of their use and their advantages which has appeared in technical literature, although of course allusions to their use in connection with various steam plants have been made in various papers.

Another curious fact is that the action of "retarders" in the flue has been generally misunderstood, as is indicated by their name. The "retarder" does of course obstruct and "retard" the flow of gas through the flue; but this is by no means the purpose for which it is placed there. If it were desired simply to make the hot gases flow more slowly through the tubes, the simplest and best way is to check the draft by dampers in the chimney or at the ash pit.

What the so-called retarder does that is beneficial is to increase the amount of heat transmitted to the tube surface from the hot gases; and it does it in two ways. First, by a mixing action upon the gas in the tube. The friction upon the surface of the retarder aids in stirring up the gas in its passage through the tube and mixing the hot gas at the center with the cold film next the surface of the tube. Also in every horizontal tube there is a tendency for the gases to be cooler in the upper part of the tube and hotter in the lower, for the upper half of the tube extracts heat far more readily from the tube than the lower half. The twist of the retarder has the effect of repeatedly "turning over" the gas in the tube as it flows along.

In the second place the retarder acts by direct radiation of heat to the tube surface. While this action may not be apparent at first sight it is of such importance that it should be clearly understood. To this end the fact should first be realized that the temperature of the tube surface exposed to the fire in any steam boiler is practically the same as that of the water in contact with it, no matter what the temperature of the gases on the other side. (We, of course, suppose the tube surface to be clean.) The reason is that water absorbs heat many times as rapidly as gas. As experimental proof I may add that in a small boiler filled with cold water I have often seen dew collect and stand in beads upon the fire side of the tube when a current of gas at a temperature of over 1,000° F. was passing through the tube.

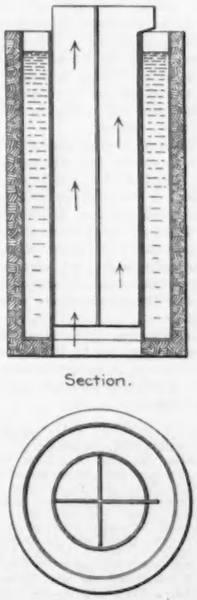
The rate of absorption of heat by boiler heating surface then, depends almost entirely on how much heat we can impart to this surface on the fire side. In the ordinary boiler tube, heat is imparted to the surface of the tube only by the contact of the hot gases. Now suppose we place in the tube any solid body, of any shape whatever. Manifestly, as it is surrounded and bathed on all sides by gases at a temperature of say 1,000°, it will, if it loses no heat, soon become of the same temperature as the hot gases. Suppose the surface of the tube is at a temperature of 300° F. Then we shall have these two surfaces only an inch or two apart and a difference of temperature between them seven times as great as exists between a very cold winter day and the maximum heat of summer. Under these circumstances, of course, the hot body at the center of the tube will energetically radiate heat to the walls of the tube and will materially increase the rate of heat transmission.

The amount of radiation in any given tube depends on the area of radiating surface and on the difference in temperature between the radiating surface and the surface of the tube. A radiator of cross shape, like that

Cross Section of Boiler Tube With Radiator Inserted.

shown in the accompanying cross section of a tube, has a radiating surface nearly 1¼ times as great as the inner surface of the tube, and experiment shows it to radiate nearly twice as much heat in a given time as a flat strip of a width equal to the tube diameter.

I have made numerous experiments to test the efficiency of radiators, with the apparatus shown in the accompanying sketch. It represents a section of a single tube of a vertical boiler. The water space surrounding it is well protected by a non-conductor, so that the loss of heat is very small. Through the tube a current of hot gas is caused to flow from a lamp, gas jet, or other suitable source and the amount of heat transmitted to the water in a given time is measured. The test is then repeated under identical conditions, except that a radiator of the form



Apparatus for Measuring Increase in Transmission of Heat to the Tube Surface due to Radiation.

shown above is placed in the tube. The increased amount of heat transmitted to the water is taken as the amount due to the radiation from the internal piece.

Experiments with this apparatus show the following general results:

(1) That the percentage of increase in heat transmitted due to radiation increases with increase in temperature of the gases passing through the tube.

(2) That the percentage of increase in heat transmitted due to radiation is larger in vertical tubes than in horizontal, on account of the fact that a given area of heating surface in a horizontal tube absorbs heat faster by direct contact with the gases than the same area in a vertical tube.

In general, the experiments showed that with vertical tube heating surface and gas passing through the tubes at a temperature sufficient for the tube to transmit 1,000 to 3,000 B. T. U. per sq. ft. per hour, the insertion of a radiator would cause an increased heat transmission of 200 B. T. U. to 1,200 B. T. U. per sq. ft. of radiating surface per hour; or, in other words, the insertion of a radiator in that part of a tube in which the gas is of high temperature appears to increase the amount of heat absorbed from 20 to 40%.

These experimental figures for the amount of heat transmitted by a radiator in a tube are corroborated by the figures for relative radiation and convection given by D. K. Clark in his treatise on the steam engine, p. 68, et seq.

The radiators possess the advantage over the spiral retarders described by Prof. Whitham, that they do not obstruct the draft to so great an extent, and they interfere less with the cleaning of tubes with the steam jet blower.

Experiments on actual boilers indicate that either device is most useful on boilers with short tubes, of not too small diameter and with an abundance of draft. With either device the tube surface must be kept clean, otherwise the increased efficiency will soon disappear, as is the case with the Serve ribbed tubes when care is not taken in this respect. It appears likely that either of these devices may be used with especial advantage, therefore, where a clean fuel like gas or oil is used. Another application of these devices which appears to have promise is to the tubes of vertical boilers of the Corliss or Manning type. An objection to these otherwise excellent types of boilers is the very high head room that is required to get in tubes long enough to extract the heat from the gases with reasonable completeness. By the use of some device to increase the tube-heating surface efficiency, a shorter tube should be permissible, with a consequent reduction in the height of the boiler.

The economic gain by the use of either radiators or retarders depends entirely on the temperature at which the boiler is discharging its hot gases. In general it may be assumed that every 100° reduction in the temperature of the waste gases represents from 5 to 10% saving in fuel.

In general it will not usually be found worth while to introduce either retarders or radiators in the tubes of any boiler unless the thermometer shows its hot gases to be discharging at a temperature of over 550° F.

I notice among Mr. Whitham's conclusions the statement that: "Retarders can be used only with fire tube boilers." This doubtless refers to the proposition to place retarders inside the water tubes, which is absurd on its face to any one correctly understanding the action of the retarders. The use of radiating bodies of extended surface, however, in the gas passages between the tubes of a water-tube boiler, should in theory at least give the same advantage as in the case of fire tubes. Two methods for effecting this radiating action devised by the writer may be found by reference to U. S. patents Nos. 529,997 and 559,021.

A 1,000 HP. VERTICAL TUBULAR BOILER has just been placed in the Cortlandt St. Station of the New York Steam Co. It weighed 119,000 lbs., and was 23 ft. long and 10 ft. in diameter. Its 220 steel flues are each 5 ins. diameter and a 7-in. circulating tube surrounds each flue and extends from near the bottom of the boiler to near the water line. The boiler was built by the Edgar Boiler Co., of Warren, Pa.

AMERICAN AGRICULTURAL MACHINERY is finding a market in Ireland. U. S. Consul Newton B. Ashby, of Dublin, in commenting on the exhibits at the recent show of the Royal Dublin Agricultural Society, says that the English and Irish agricultural tools are as a rule much heavier in make and more clumsy in appearance than the corresponding American tools. He believes that it would be well to study the prejudices of the farmers and build heavier machines for sale in this market.

NEARLY $400,000,000 is the total of British capital which was invested in various enterprises floated on the London stock market during the first six months of 1896, according to the London "Economist," the actual figures being £79,494,000. Of this sum about £11,000,000 was invested in loans of foreign governments, and about an equal sum, it is amusing to note, in companies formed to manufacture cycles and cycling appliances.

THE EFFECT OF ELECTRICITY ON PROJECTILES while in flight has been illustrated by some recent trials of the Swiss army rifle. The "Journal de Geneve" states that during this trial strange deflections of the bullets were noticed that could not be accounted for until it was discovered that an electric line paralleled the range. Experiments were made by building a line of four steel cables the full length of the range, 780 ft., and about 120 ft. from it. When these cables carried a heavy current of electricity the lateral deflection for this distance was about 70 ft. For a longer range the deflection was much increased; with artillery and a range of 9,000 ft. the deflection from the true line is claimed to reach the enormous amount of 14°. It is not stated whether the deviation is toward or away from the electrical current.

ELECTRICAL SUBWAYS are to be built by the city of Minneapolis in all streets which are to be paved with asphalt. Space will be provided sufficient for the use of the city and for all companies having electric wires of any sort in the streets. The work will be in charge of Mr. F. W. Cappelen, city engineer, and is expected to cost about $90,000.

ELECTRIC MOTORS have been installed to operate the swing span of the new highway bridge across the Connecticut River, from Middletown to Portland, Conn. Four General Electric 800 motors are used, one of which swings the span, two others operate each the lifting mechanism at one end of the span, and the fourth is held in reserve. The span is 450 ft. in length, and we are informed that previous to the installation of the electric motors 15 men were required to start the bridge and 8 to swing it.

A PNEUMATIC TUBE POSTAL SYSTEM is reported to be contemplated in Philadelphia to connect the main post office with the sub-stations. A half-mile tube, 6½ ins. diameter, from the Philadelphia Stock Exchange to the post office has been in successful operation for some years.

THE EXPOSITION BUILDINGS, AT ATLANTA, GA., have been badly injured by prolonged and heavy rains. The manufactures and liberal arts building is almost totally destroyed. It had a flat gravel roof on which the water collected, owing to stoppages in the water pipes, and the weight of water caused its collapse.

THE ARCHITECTURAL APPEARANCE OF THE NEW East River Bridge is engaging the attention of the Commission in charge of the work. Mr. Selim H. Peabody, a member of the Commission, proposes the appointment of an architect to co-operate with the Chief Engineer, Mr. L. L. Buck, in designing details of the structure, such as balustrades, lamp-posts, etc., so as to produce the most pleasing effect. The suggestion is an eminently sound one, and it is to be hoped that it may be carried out.

AN ENGINEER CORPS is a novel feature of the staff of Brigadier-General Wheeler of the Illinois Militia. The staff has been organized by Capt. J. I. Kelly, and among its members are Albert F. Reichmann, assistant bridge engineer of the Chicago, Milwaukee and St. Paul Ry.; W. H. Finley, bridge engineer of the Chicago & Northwestern Ry.; C. L. Crabbs, assistant engineer of the Metropolitan Elevated R. R.; Jules Roemheld, Superintendent of Bridges of Chicago; J. W. Crissey, assistant engineer of the Metropolitan Elevated R. R.; and Fred E. Mather, architect. The corps is expected to become proficient in the construction of fortifications, military bridges, etc.

A CODE OF ETHICS was adopted by the Denver chapter of the American Institute of Architects at its meeting on July 6. The following extracts from it are published in a Denver daily paper:

No member should enter into partnership, in any form or degree with any builder, contractor or manufacturer.

No member should guarantee an estimate or contract by personal bond.

It is unprofessional to offer drawings or other services "on approval" and without adequate pecuniary compensation.

It is unprofessional to make alterations or to complete a building in the course of construction designed by another architect, until satisfactory settlement has been made with the first architect, unless dishonest practice on the part of the first architect has been proven.

It is unprofessional to attempt to supplant an architect after definite steps have been taken toward his employment.

No member shall compete in the amount of compensation, or offer to work for less than another, in order to secure the work.

It is unprofessional to work for less compensation than that indicated by the schedule of charges adopted by the American Institute of Architects, which is as follows: For full professional services, including supervision, 5% of the cost of the work. For drawings, specifications and details without supervision, 3½%. For alterations and additions an additional charge to be made, in proportion to the extra labor involved. Necessary traveling expenses to be paid by the client.

TRIPLE SCREWS are to be adopted on two battleships and five cruisers to be built by the German government.

THE LATEST AIRSHIP INVENTOR is one John F. Cooley, of Philadelphia. According to the newspapers he is about to construct "a mammoth 200-ft. air ship, at Charlotte, N. Y." The apparatus is to be of the inclined plane type, propelled by gasoline motors.

THE GALVESTON JETTIES are rapidly approaching completion to the point fixed by the project of 1886, which was the 30-ft. contour. On July 9, according to the Houston "Post," the trestle of the south jetty was within 400 ft. of the proposed terminus and the trestle of the north jetty was 800 ft. from its terminus. The same authority states that whereas the engineer's estimate of the cost of the work in 1886 was $7,000,000, it now appears that the entire work will be completed for nearly a half-million dollars less.

BOOK REVIEWS.

STEEL IN CONSTRUCTION.—Convenient Rules, Formulas and Tables for the Strength of Steel Shapes Used as Beams, Struts, Shafts, Etc., Made by the Pencoyd Iron Works. A. & P. Roberts & Co., Philadelphia, Pa. 12mo; cloth; pp. 232; illustrated.

This is the ninth edition of the familiar little handbook published by the A. & P. Roberts & Co., and like former editions it contains besides tables of weights and dimensions a large number of formulas, rules and instructions for the use of the different shapes in construction. There are numerous cuts in the text and 30 full page plates, and also a very adequate index.

CHEMISTRY AT A GLANCE.—A Study in Molecular Architecture. Issued in Series. No. 1, Oxides. By Herbert B. Tuttle, 131 Lexington Ave., New York. Pamph. 8vo.; pp. 59; 60 cts.

In this pamphlet are given diagrams showing for over 200 chemical substances the structure of the molecules, according to the generally accepted theory of such structure. Those unfamiliar with chemistry may not be aware of the fact that the position of atoms in a molecule may be as important in determining the nature of a substance as the nature of the atoms. Thus alcohol, a liquid, and methyl ether, a gas, have each the same composition and the same chemical symbol ($C_2 H_6 O$).

The knowledge of molecular structure is therefore often very important to a working chemist, and this handy volume will be found convenient by many, we presume, as a work of reference. We do not see why the author does not give together with his "architectural formulas" the ordinary formulas also. They might be a convenience to some who are not familiar with current chemical nomenclature. For example, the formula given for silicon triethyl oxide, alias silico-heptyl oxide, takes up three-quarters of a page, being an architectural structure, 18 stories high. We find that it contains 30 H's 12 C's, 2 Si's and an O. Might not its formula $H_{30} C_{12} Si_2 O$ also be given?

WATER SOFTENING AND PURIFICATION.—The Softening and Clarification of Hard and Dirty Waters. By Harold Collet (Stanhope Water Engineering Co., Limited, London). London: E. & F. N. Spon & Co., New York: Spon & Chamberlain. 12mo.; cloth; pp. 168; 12 illustrations. $2.

This book is almost wholly devoted to water softening, with a little matter relating to the removal of iron and to the clarification of water. The information on clarification is not only meager, but fails to convey an adequate idea of clarification processes, practically ignoring mechanical filtration as practiced in this country.

The author sets forth the chemical and other characteristics of hard water, noting especially the objections to its use for household and industrial purposes. The various chemicals used for softening are discussed and their chemical action stated.

No descriptions of softening plants in actual use are given, but some apparatus for this purpose is described and illustrated. The fact that practically all the devices presented are made by the company with which the author is connected raises the question whether the book is not intended as much as anything else for an advertisement. The name of the author's company follows directly after his own on the title page; the devices described are frankly credited to the company; and the reading matter is followed by advertisements of the company, the only ones in the book.

Much of the information given is of such a character that it would not be affected by the fact that the writer is personally interested in certain processes, but most, if not all, books written under such circumstances need to be read with caution.

DIRECTORY TO THE IRON AND STEEL WORKS OF THE UNITED STATES.—Embracing a full list of the Blast Furnaces, Rolling Mills, Steel Works, Tinplate Works, Forges and Bloomaries; also of all the Wire Rod Mills, Wire Mills, Cut-Nail Works, Wire-Nail and Horse-Nail Works, Car Axle Works, Car Wheel Works, Car Building Works, Locomotive Works, Cast and Wrought Iron Pipe Works, Malleable Iron Works, Shipbuilding Works and Bridge Building Works. To which is added a complete list of the Iron and Steel Works of Canada and Mexico.—Compiled and published by the American Iron and Steel Association, Philadelphia, Pa. Cloth; 8vo.; pp. 334. $6.

This is the thirteenth edition of this well-known directory, which is published every two years, and its scope is pretty clearly shown by the sub-title quoted in full above. Since the edition of 1894 was issued a large number of new enterprises have been undertaken, including a surprisingly large number of sheet mills and tinplate works. The list of malleable iron works is a new feature of the directory. The directory includes 469 blast furnaces, with a capacity of 17,373,637 tons per annum; 505 rolling mills and steel works, of which 463 contain trains of rolls; 4,408 puddling furnaces; 44 standard Bessemer steel works, with 95 converters; 3 Clapp-Griffiths and 4 Robert-Bessemer steel plants, the annual converting capacity of all the Bessemer steel works being 9,472,350 gross tons of ingots and direct castings; 88 completed open-hearth steel plants, and 4 in course of erection; the annual capacity being 2,430,450 gross tons; 35 open-hearth plants prepared to manufacture castings; 45 crucible steel plants; 53 cut nail mills with 4,598 machines; 53 wire nail works; 23 works for rolling wire rods; 73 wire-drawing works; 156 completed plate mills; 69 tinplate works; 23 forges and bloomaries; 74 bridge works; 108 pipe and tube works, 112 car wheel works, etc.

The equipment and capacity of each plant, the date of construction, the names of officers and other interesting information is given. All this matter has been entirely rewritten. The establishments are classified by their products and arranged alphabetically in this classification, while there is an index to the names of works and companies, and to the principal brands of pig iron. The book is well printed and neatly bound, and is an invaluable work of reference for all persons interested in the iron and steel industries.

THE SAN FRANCISCO CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

By F. S. Odell, M. Am. Soc. C. E.

The 28th Annual Convention of the American Society of Civil Engineers was held in San Francisco, June 29 to July 2. A nucleus formed by the Eastern members with their families and friends to the number of 28 left Grand Central Depot, New York, on June 22, at 6 p. m. Other members joined the party at various points en route until a very creditable representation gathered at San Francisco.

The details of the itinerary were arranged and the party conducted by Raymond & Whitcomb.

The first stage of the journey ending at Chicago was swiftly accomplished over the New York Central and Lake Shore & Michigan Southern railways. At Chicago a stop of an hour and a transfer to the Chicago, Rock Island & Pacific R. R. was made. The following day, June 24, was passed amid the wheat and corn fields of Iowa and Nebraska, where the luxurious growth of leaf and stalk gives promise of abundant harvests. Another night is passed and the party awakens on the morning of the 25th on the Colorado plains. Either there has been an unusual amount of rainfall in this region this year or man has made great conquests on these arid plains within the ten years since the American Society of Civil Engineers held its convention in Denver. Certainly a very great change is evident since then. Man has taken possession; the whole country is fenced in, cattle and sheep are seen on every side, the slopes appear somewhat verdent and even the little prairie dogs and jack rabbits have mostly disappeared.

The party take a late breakfast at Colorado Springs and go on to Manitou.

If the plains of Colorado have changed, what may be said of the towns? Colorado Springs has become a thriving city, and the Manitou of ten years ago could not be recognized were it not for the unchangeable mountains. A trolley line now makes frequent trips between Colorado Springs and Manitou, running as far up as the Iron Ute Spring. Houses and shops line the street all the way, and, climbing out of the narrow valley, perch in picturesque locations on the mountain sides and cap the summits of the foothills. A good wagon road leads up William's Canon to the Cave of the Winds, and a railway ascends the old Pikes Peak trail to the summit of the mountain.

The party availed itself to the fullest extent of the opportunity to enjoy the wonderful scenery; the canons were diligently explored, the Garden of the Gods was visited, Pike's Peak ascended, a great volume of rarefied air inhaled and quantities of the pungent, sparkling waters imbibed.

Unfortunately for those ascending the 14,200 feet of Pike's Peak, the day was somewhat overcast and the summit enveloped in clouds, but the magnificent views obtained during the ascent and descent, and the exhilaration of the lofty altitude, were considered sufficient compensation. The hours fled all too quickly, and every one regretted that the stay was so brief, as it would take a week at least to thoroughly "do" Manitou.

A good night's rest and the journey is renewed on the 26th by special train on the Denver & Rio Grande R. R. This special train added very greatly to the pleasure of the journey—stops being prolonged at points and places of special interest to the party, while others of less attraction were omitted altogether. At 11 a. m., Pueblo, "the Pittsburg of the West," is reached. Here are abundant signs of progress, hither is brought the product of the mines, iron ores, coal, gold and silver, here the ores are smelted and rolled into commercial forms. Some fine public buildings are noted, among them the State Normal College; also many handsome residences, as well as the remains of some old adobe houses still peopled by Mexicans, a strange blending of ancient and modern life.

From Pueblo westward, the railway follows the Arkansas River, which flows through a broad valley at Pueblo, along which frequent irrigation flumes and ditches are seen leading water from the river upon the arid and parched bottom lands, which at once respond with luxuriant growths of alfalfa, corn and other cereals.

As the train speeds onward the valley contracts, the mountains seem to bar the way and forbid further progress, but the roadway glides around the base of a lofty mountain and makes its sinuous passage along the verge of the river, which has here become a narrow, foaming torrent, occupying the full width of the gorge from which the rocky walls of the cliffs rise almost per-

pendicular to the height of a thousand feet or more, the climax is reached at the Royal Gorge, where the cliffs on either side approach each other so closely that there is no room for the railway, so the engineers in the original construction bridged the river lengthwise, or, in other words, hung up the railway above the river on long girders suspended from rafters like trusses thrown across the canon and buttressed against the solid walls of the cliffs on either side of the river.

The railway as originally constructed through the canon was narrow gage, but has since been widened to standard, and in the reconstruction it was found practicable to build a heavy retaining wall under the suspended bridges, so now it is more ornamental than useful, but it affords an excellent object lesson of the readiness with which the engineers surmounted a difficult obstacle in a novel and unusual manner, and it is to their credit that if they erred it was on the side of greater security in construction. The scenery at the Royal Gorge and for miles through the canon is wonderful beyond description, the mountains rising almost vertical for thousands of feet, and as the train moves onward, taking various forms, rent by side canons of marvelous wildness and beauty, the traveler is entertained with a kaleidoscopic series of views that can never be forgotten.

At Salida we stop for dinner and then proceed through Leadville, the most westerly town visited by the convention party in 1886. Only a brief stop was made and the ascent was begun to Tennessee Pass at the Continental Divide, which attains an altitude of 10,418 ft., the highest elevation passed over in the train during the trip. The railway passes under the summit through a tunnel, the Arkansas River and the Atlantic slope are left behind, and the descent toward the Pacific is begun. The Eagle River is followed until it empties into the Grand. In the Eagle canon the train is stopped to view some mining operations at the Belden mines. These are very rich gold producing mines, the entrances to the shafts are hundreds of feet up the mountains, where buildings containing the hoisting machinery can be seen. Communication with the valley and railway is had by means of cableways. To the uninitiated it looks like a very improbable place to find precious metals. Further down the valley of the Eagle, large lava beds are seen on the easterly side of the river. Apparently the lava has been forced from fissures in the mountain, as no crater appears. At the Grand another canon is entered, which if not so sublime as that of the Arkansas, is equally wonderful, and by some is considered more beautiful, the cliffs taking the forms of Egyptian architecture and rising into suggestions of temples and theatres, but we are surfeited with mountains and canons, and while the day has been crowded with marvelous scenes and interesting features, all are so wearied that a few hours' rest with a bath in the warm sulphur water and a good supper at Glenwood Springs is most welcome. We find this place a gem set in the mountains, with a commodious and well appointed hotel, ample lawn, verdant with grass and shaded with trees and vines, large bath houses with all the appliances for bathing in luxury. A large swimming pool, fed by a gushing sulphur spring that sends out sparkling crystal water at a temperature of about 120° F.; the water in the pool is kept at a pleasant temperature for bathing by the admixture of a sufficient quantity of cold water. Bathing in the open pool is indulged in at any time of year, even in the coldest of weather and amid snow storms.

Supper is taken at the hotel; a delightful siesta on the veranda, with coffee, cigars and the accompaniments of music and an electric fountain, a dream of delight. Again the cars are taken and the weary members of the party seek their berths. Later the cars are attached to the regular train and the journey is resumed.

The next morning, June 26, the aspect has changed wonderfully; we are in Utah; the mountains are lost to view and barrenness and desolation is all that meets the eye. On these alkali plains, with a scanty growth of sage bush, a solitary coyote, gaunt and ill-favored, gives the finishing touch to a landscape that for dreariness can hardly be surpassed. This continues for miles and miles until the Valley of the Jordan is approached, where, under the influence of irrigation and cultivation, the soil is very productive; grass and grain wave in the meadows, the trees are prolific in fruits, and flowers bloom in the gardens by the roadside.

Salt Lake City is passed with dissolving views of the Tabernacle and New Temple, the latter a notable work of architecture. Thus far the genius of these Mormon architects seem to have been expended on the ecclesiastical structures, and but little appears in the homes of the people. We follow the northeasterly shores of the Great Salt Lake for many miles, look out on its sparkling waters and inwardly long to plunge in and free ourselves from the soot and dust of the day's journey. Ogden is passed with a brief stop, and we enter the desert of Northwestern Utah and awaken on the 27th in a similar desert in Nevada. Nor do we find much that is not desert in crossing the whole state on the line of the Central Pacific Ry. We are told the entire state has a population of not more than 50,000, and that it is decreasing in the number of its inhabitants.

That the soil is not unproductive, however, is demonstrated at Humboldt, a station on the railway where water is had for irrigation and which is a veritable oasis in a dreadful desert. A story is related of an enthusiastic native who, in extolling the advantages of his state to an Eastern man, declared that all they needed was plenty of water and good society. His companion replied he had heard that is all that is lacking in hell!

At Humboldt the first Indians were seen—two Piute squaws—one in brilliant paint. The photographic fiends of the party went into ecstasies at once, though it was difficult to get even satisfactory snap-shots owing to the aversion of the Indians to being photographed. They have learned the tricks of the Kodak and other wiles of the amateur photographer. However, at stations further on, by strategy and a liberal use of coin of the realm, a number of quite satisfactory likenesses of some squaws and their papooses were obtained.

Breakfast and dinner were taken on the dining car. At noon we were met by Mr. W. G. Curtis, Assistant to the General Manager of the Pacific System of the Southern Pacific Co.; Geo. E. Gray and Col. Geo. H. Mendell, Corps of Engineers, U. S. A., and other members of the Local Reception Committee who had come out in a private car to meet and welcome us.

From the moment of their arrival the local committee were most assiduous in their attentions to their guests, and until we parted from them at Ashland, Ore., on July 5, they never ceased their ministry to our comfort and enjoyment. The first intimation of their hospitable attentions appeared immediately after their arrival when a number of crates of the most delicious strawberries, apricots and peaches were distributed through the cars with the "compliments of the local committee."

The state line is crossed, and we enter California about 2 p. m. The Truckee River, which we are following, soon leads into the mountains, and after pausing a few minutes at Truckee we are soon among the snow-capped Sierras, and are again enchanted with beautiful mountain scenery. As we slowly ascend toward the summit of the range magnificent views greet us at every turn until we are engulfed in snow sheds and ride mile after mile in a sort of nightmare vainly hoping in a few minutes to come out into the open and get full views of what we are sure, from the tantalizing glimpses we get through the cracks between the boards, must be grand and beautiful scenery. But we hope in vain, for not until we have reeled off some 42 miles of darkness do we emerge from the sheds into daylight again, and then we have passed far down from the summit. The necessity for these snow sheds was very evident, as we could still see snow banks outside as high as the car windows.

A series of small mishaps had occurred to the train. Between Denver and Sacramento three draw-bars were broken. Each occasioned delay for repairs, so Oakland was reached about four hours behind time; further delay occurred at the ferry, and the party did not finally reach the Palace Hotel in San Francisco until about 3 a. m., June 29.

The sessions of the convention began at 10 a. m., on the 29th.

The following are brief abstracts of the papers presented, all of which were published in full in the May number of society's proceedings:

Flow of Water in Wrought and Cast Iron Pipes from 28 to 42-ins. Diameter.

This paper by Mr. Isaac W. Smith, M. Am. Soc. C. E., dealt with investigations made on the flow of water in the pipe lines, which carry the water from Bull Run River to the city of Portland, Ore. The water supply is taken from the river by means of a canal terminating in a funnel mouth connecting with the 42-in. discharge pipe. The water is conducted to the city through 24 miles of riveted steel pipe and 6 miles of cast-iron pipe. The steel pipe is 42, 35 and 33 ins. diameter, and the cast-iron pipe 32 and 28 ins. diameter, the latter diameter being used for a distance of 2,000 ft. to carry the pipe line under the Willamette River. On March 28, 1895, there were 2,995,000 gallons, by reservoir measurement, turned into reservoir No. 1 in 3.7 hours and 617,000 gallons into other reservoirs, making 3,162,000 gallons in 3.7 hours, or 23,410,000 gallons in 24 hours. The flow by weir was 23,750,000 gallons, or 340,000 more than the reservoir and weir measurements combined. On Jan. 21, 1896, all the water was let out of the reservoir and the full flow from Bull Run River turned in, the time being noted as the water level reached each million gallon mark; time being 61 minutes in seven cases, and 62 minutes in three cases, or 10 hours, 13 mins. for 10,000,000 gallons, equivalent to 23,491,000 gallons in 24 hours. On Feb. 27, 1896, the discharge was 23,500,000 gallons through the riveted pipes and 20,750,000 through the cast-iron pipes.

A Water Power and Compressed Air Transmission Plant for the North Star Mining Co., Grass Valley, Cal.

This paper by Mr. A. D. Foote, M. Am. Soc. C. E., described a plant in which air compressors with cylinders 10 × 24 and 18 × 24 ins. are driven by a Pelton water wheel 18 ft. 6 ins. diameter, making 110 revolutions per minute, the water being taken from a canal and conveyed through 2½ miles of 22-in. riveted iron pipe and 7,070 ft. of 20-in. riveted steel pipe, the head being 775 ft. This plant was described and illustrated in our issue of Dec. 19, 1895.

The Condition of Steel in Bridge Pins.

Mr. A. C. Cunningham, M. Am. Soc. C. E., has made a number of investigations as to the strength and quality of steel pins for bridge work, and finds that when they are tested for quality and not for the purpose of getting them past a specification, it is found that forged pins are better than rolled pins, and that a medium hard steel of about 70,000 lbs. ultimate tensile strength will give better results than a soft steel. The tests (a number of which are given in tabular form) show that bridge pins, even when made from a special quality of steel, are not in a uniform condition; the interior portions show a lack of work, and may show excessive segregation, which in steel of common quality is liable to reach a dangerous amount. It is also shown that pins are improved by annealing. The following specification is submitted as being likely to procure as good bridge pins as can be had in common practice:

Bridge pins shall be made of open-hearth steel. If made of acid steel, the cast analysis shall show not more than 0.06% of phosphorus, nor more than 0.03% of sulphur. If made of basic steel the cast analysis shall show not more than 0.03% of phosphorus, nor more than 0.03% of sulphur. The manganese for either steel shall be not less than 0.5% nor more than 0.8%.

The smallest diameter of the final bloom or ingot to be made into pins shall be at least 50% greater than the diameter of the pin.

All pins shall be stamped with the cast number of the steel from which they are made and shall be stamped with consecutive numbers from the bottom of the ingot to the top.

After pins have been manufactured to diameter, they shall be slowly and uniformly heated to a dark red heat in a suitable furnace, and left to cool slowly for a period of not less than 24 hours. Test pieces cut from near the surface of annealed pins, and of a sectional area of not less than ½ sq. in. shall have an ultimate strength of not less than 60,000, nor more than 70,000 lbs., per sq. in., an elastic limit of not less than half the ultimate strength, an elongation in 8 ins. of not less than 20%, and a reduction of area at fracture of not less than 40%. Test pieces cut from near the center of pins shall comply with the above requirements, except that a fall of 5,000 lbs. in ultimate strength, and a fall of 5% in reduction of area will be allowed.

The fracture of all pin tests shall be free from granulation.

Analyses of drillings taken from near the surface of pins shall not exceed the limits of the cast analysis by more than 10%, and, when taken from near the center, shall not exceed said limits by more than 50%.

Tests and analyses shall be made on such pins as the engineer shall designate.

The Construction of a Light Mountain Railway in the Republic of Colombia.

The railway in question was built for the Caribbean Manganese Co., of Baltimore, Md., and extends from the harbor of Nombre de Dios to the manganese mines, the main line now in operation being about nine miles long. The author of the paper, Mr. E. J. Chibas, Assoc. M. Am. Soc. C. E., was the engineer. The surveys and location were made with difficulty owing to the dense forest and undergrowth, and the absence of paths or roads. During about six months suspension of work, luxuriant vegetation, 5 to 7 ft. high, covered the right of way, which had been cleared and grubbed, and some of the centre stakes were growing into trees. The bridge work gave considerable trouble, the native carpenters being unable to work from plans, and being such poor workmen that they had to be watched to keep them from spoiling the timber when the whole work had been laid out for them. The embankments were only 7 to 8 ft. wide on top, the idea being to widen them with refuse from the mines during operation, but the author did not consider a less width than 10 ft. advisable for a line of 3 ft. gage. The cuts are 10 ft. wide, but 12 ft. would have been better. In pick and shovel work, and in nearly all manual labor, Jamaica negroes proved superior to the natives. The track is laid with 35 lb. rails on 2,200 ties per mile, the ties being usually 6 × 6 or 5 × 6 ins., 6 ft. long. The ballast is a decomposed rock obtained from the cuts. The curvature of the line aggregates about 30% of the total length. The cost of building and equipping 10½ miles of line averaged $13,400 per mile. The average for the Nombre de Dios branch (including wharf, buildings and port terminals) was $6,800 per mile.

Improving the Entrance to a Bar Harbor by a Single Jetty.

In this paper, Capt. T. W. Symons, M. Am. Soc. C. E., U. S. Engineer Corps, describes a plan prepared for the improvement of the entrance to Gray's Harbor, Wash., by means of a single jetty. this plan being applicable here on account of the relations of the currents, tides, volume of flowing water, and other conditions. In general two parallel or converging jetties are used, or one jetty with the other replaced by a headland or permanent shore, but the author believes, from his experience on the Pacific coast, that there are places where double jetties are unnecessary. Such a plan has been successfully carried out at Coos Bay, Ore., and the plan proposed for Gray's Harbor is based largely upon the results obtained and studies made at Coos Bay. The jetty, as proposed, is to be of rubble stone or a brush mattress foundation, the jetty reaching up to the level of high tide, and its total length (to the crest of the bar) being 25,500 ft. The cost of the wall is estimated at $1,000,000, as compared with $2,500,000 for a plan involving two jetties.

Interesting discussions followed the reading of these papers, especially that by Mr. Cunningham.

In the evening a reception was given at the hotel which was largely attended by distinguished citizens of the city and vicinity, and many pleasant acquaintances were made.

On Tuesday, the 30th, the local committee tendered the party an excursion in a steamer on the bay and to the

Union Iron Works. The harbor and Golden Gate were seen to advantage. Luncheon was served on board the steamer, after which appropriate speeches were made. An inspection of the new U. S. battleship "Oregon," now under construction, and of the Union Iron Works completed the day's sightseeing and pleasures. In the evening President Clarke's address (Eng. News, July 2) was read by the Secretary, Mr. Charles Warren Hunt, Mr. Clarke not being present. This closed the formal labors of the convention, and the visiting members and friends committed themselves unreservedly to the hands of the local committee, and for the remainder of the stay in California "joy was unconfined."

The following day the party visited Mayor Sutro's beautiful residence and park, dined at the Cliff House, where hospitality flowed so freely that guests who had never spoken before made speeches and afterwards saw sea serpents or rather seals on the rocks in the bay.

The freedom of the city was conferred upon the visitors. They were invited to the Board of Trade; the Bohemian Club opened wide its doors; everywhere hospitalities were lavished and people "fell over each other" in their efforts to do honor and afford pleasure to the American Society of Civil Engineers.

On July 2, by courtesy of the local committee, an excursion, to which a large number of resident citizens were invited, started by special train to visit the Spring Valley Water-works, Leland Stanford, Jr, University, and Monterey. At San Mateo a large number of conveyances met the train and the party drove several miles throughout a pleasant country to the famous dam of the Spring Valley Water Co., about which so much has been said and written that it has become very familiar to the engineering profession. A thorough examination of the structure was made, and full explanations of the details of construction, were given by Mr. Herman Schussler, Chief Engineer of the Spring Valley Water Co. Then the drive along the lake was resumed until a pleasant grove was reached, where on long tables under the trees a feast was spread with everything pleasant to eat and drink in great abundance. Liquids—not all of which originated in the lake—flowed redundantly and good cheer prevailed. After the feast a very rich program of after-dinner speeches was served, by men of all professions and occupations, from bishop to banker.

Again the carriages were taken and the party boarded the train at San Mateo, full of gratitude to the Spring Valley Water Co. for the delightful carriage ride and dinner. From San Mateo the train sped through one of the garden spots of California—a great grain and fruit-growing belt, through thousands of acres of wheat white for the harvest, where machines operated by 28 horses thresh the grain as it is cut and drop it off in bags, through beautiful parks of live oak, through miles of fruit orchards, apples, peaches, apricots, prunes and cherries, through hundreds of acres of seed onions and sweet peas—everything is on a most generous scale in this country.

We stopped a few minutes at Palo Alto, got a glimpse of the grounds and buildings of the Leland Stanford, Jr., University, and then hastened onward through San Jose where we could see upon Mt. Hamilton, 28 miles to the eastward, a white speck that indicates the location of Lick Observatory, with its world-renowned telescope. At last we approach Monterey and are soon at the Hotel Del Monte. In the evening, as we view the hotel and park, it seems a veritable fairy land, an impression which the light of the following day fully justifies, for the place is lovely almost beyond conception. Nature and man have co-operated in perfect union and harmony in the creation of the Del Monte. Nature laid the foundation, planted the great oaks and cypresses, and man erected the beautiful hotel and cultivated and adorned the park with consummate taste, harmony and skill. All the flowers that will thrive in the congenial soil of Central California here unfold in exuberant bloom; strange, fantastic, semi-tropical plants exhibit their foliage in the Arizona Garden; tempting vistas with paths leading in every direction invite to strolls in the park. Of all the places visited during the trip none approaches Del Monte for loveliness.

Time and space fail to give in detail a proper description of the delightful drive of 18 miles on the 3d of July through the quaint old town of Monterey, located irregularly on the Bay of Monterey—through Pacific Grove, the Chatauqua of the Pacific coast, on through an immense natural park to the ocean, along the ocean to Cypress Point, with its fantastic forest of hoary wind-swept cypress trees, reputed to be as ancient as the cedars of Lebanon—on back to Monterey, and the Hotel Del Monte, and dinner; after which the train is again taken, and the return journey made to San Francisco, via, Santa Cruz and over the Santa Cruz Mountains, passing a grove of "big trees," some of the smallest of their kind, but one of which ("Fremont's tree") still standing and growing, easily accommodated 34 of the party with room to spare in its hollow interior.

According to the program, the time had arrived to leave California, but our hospitable hosts importuned us to stay another day, as they would not be satisfied without showing us something further of the material development of their wonderful state.

Yielding to their solicitations, another night was spent in San Francisco, and on the morrow, July 4, under escort of the local committee the party was taken to Sacramento and thence to Folsom, to examine the electric power plant located on the American River at that place, and illustrated and described in Engineering News of April 11, 1895, and May 7, 1896.

The electric current is transmitted from Folsom to Sacramento, 22 miles, and furnishes the motive power for all the electric street car lines in the city. The shops of the Southern Pacific Ry. are also supplied with electric power and experiments are being made to determine whether it will be sufficiently economical to warrant extending the use of the electric power to all the shop uses.

It is to be noted that a difficult engineering problem seems to have been satisfactorily solved in this water-power plant. It has been found that in diverting the water from rapid silt-bearing rivers like the American, very great difficulty has been encountered in keeping the comparatively slow flowing canals from becoming filled by deposits of silt. This difficulty is overcome at the Folsom dam by what is virtually a large settling basin, in the bottom of which are outlets, passages and gates, through which the sediment is washed into the river below the dam at intervals and only the water freed from its burden of silt is allowed to pass through the headgates into the canal. The gates are controlled and operated by hydraulic jacks and are very easily handled.

Near the dam is located the state prison, to which a brief visit was made, and the remainder of the afternoon was spent in Sacramento, where points of interest were visited the state capital with its very beautiful park, the historical Sutter's Fort and other places. The "glorious Fourth" was celebrated by the natives with characteristic Western energy and vim. To the ladies of the party who had not satisfied themselves with curios in Chinatown at San Francisco, another opportunity was presented in the Japanese bazaars of Sacramento, which were the only shops open on the Fourth.

About 9 in the evening a start was made toward the North, and on awakening the following morning the train was keeping company with the Sacramento River, which as it comes from the mountains is a clear, sparkling stream easily forded. We stopped at Craig, a resort in the mountains, with an outlook on Mt. Shasta, a wonderful peak, rising 14,442 ft., covered with a beautiful mantle of perpetual snow. We pass Castle Gate and are apparently lost in the mountains. Moss Brae Falls are seen, a series of dainty cascades, springing out from a drapery of verdant moss and foliage, and leaping and bounding down the steep mountain side to the valley below. Not far beyond we come to the famous Shasta mineral springs. After slaking our thirst with the cool, pungent water, the journey was renewed, penetrating further into the mountains and rising by loops and turns to the summit of the divide between the waters of the Sacramento and the Umpqua rivers, and as we rise we gain ever new views of beautiful Mt. Shasta, traveling nearly all day in sight of it.

About 4 p. m., our friends of the local committee, Mr. Curtis and Colonel Gray, who had accompanied us beyond the state line of California, parted from us at Ashland, Ore.

Too much praise cannot be given to our fellow members of the American Society of Civil Engineers on the Pacific coast and their friends for the magnificent hospitality which they extended to their visiting guests. From San Francisco to Tacoma attentions were showered upon the visitors and nothing was left undone that could add to their comfort or pleasure. The local committee of San Francisco, headed by their chairman, Mr. Curtis, were particularly assiduous and successful in their efforts to render the convention memorable by the heartiness of their welcome, and the wealth of good things prepared for their guests.

The remainder of the journey to Portland was pleasantly passed. The railway runs through some treacherous country, where slides occur, at one point the portal of a tunnel was once closed by a slide, and at another three miles of the road were buried under an avalanche of earth and debris which dropped from the mountain side, creating a temporary dam which formed a lake some miles in extent. This was speedily emptied when the dam gave way soon after the water began to pass its crest.

Portland was reached early on July 6. After breakfast at "The Portland" the party was conducted about the city and to Portland Heights, from which magnificent views of the surrounding country were had, the three great mountain peaks, St. Helens, Adams and Hood, like stars of the first magnitude, claim special attention, standing separate and apart, each mantled with perpetual snow.

Our Portland friends had arranged a trip by train to the Cascades and Locks, about 50 miles up the Columbia River. Here more beautiful scenery was enjoyed, the Locks were inspected, lunch was taken, and a salmon wheel was visited. The wheel is propelled by the current, and carries large buckets or scoops, which gather all the fish within their reach and deposit them on a platform.

But few of the party from the East had any conception of the abundance of fish or the size to which they attain in these Western rivers; and the sight of 50-lb. fish as they came flopping from the wheel was a revelation. It seems, however, a barbarous way of fishing and is prohibited by law by our Canadian neighbors.

Returning to Portland, the journey north was resumed, and Tacoma was reached late in the evening.

Here, as elsewhere, we were royally received, and were escorted about the town to view its sights.

In the afternoon the party were taken on an excursion to Point Defiance, and by steamer on the bay. In the evening an informal reception was held at the Tacoma, after which the party began disintegrating, a number leaving for the Yellowstone Park. Those remaining started northward again in the morning, July 8, by steamer, touching at Seattle and Port Townsend, and stopping at Victoria for a few hours for supper and a trip through the town.

Morning found us at Vancouver, which is a thriving city and an important port.

From here the journey east over the Canadian Pacific Ry. was begun. The water in the rivers was very high, thousands of acres were flooded on either side the railway. As the afternoon wore away, however, the submerged plains were left behind and we were again enjoying picturesque scenery in the Fraser Canon which was followed until daylight faded into darkness.

The morning of the 10th found the party in the Lake region, circling the shores of the great Lake Shuswap, which the railway follows for 50 miles. The Lake is hemmed in by mountains rising high on every side and covered with virgin forest.

The country is said to bear a strong resemblance to the lake country of Scotland. It is a paradise for sportsmen, the forests abounding in large game and the lakes in fish and water fowl.

Leaving the Lake country the descent is made to the westerly crossing of the Columbia River at Revelstoke, the railway runs in an easterly direction up the Canon of the Illecilliwaet, leaving the Columbia, which makes a long detour to the north sweeping around the Selkirk Mountains. South of Revelstoke it widens into the Anow Lakes.

The Illecilliwaet is a torrential mountain stream fed by the melting snows seen on all sides on the summits of the lofty mountains of the Selkirk range. Recent hot weather had swollen all the streams, making the waters turbulent and muddy; the valleys were flooded, the rails of the railway being at times covered to the depth of 6 to 12 ins. A trestle on the line was started from its foundation and the train was stalled at a small station in the mountains in company with another train which had already been waiting for 24 hours.

A weary wait with frantic efforts to get into communication with the railway officials, who were empowered to advance the train and transfer the party to Glacier, an interesting and comfortable station to spend the waiting hours, failed to meet with success. Dinner and supper were taken on the dining car, and one by one the party retired for the night.

At midnight the road was opened, and the party was joined by Chief Engineer P. Alex. Peterson, M. Am. Soc. C. E., who had been superintending the repairs at the trestle, and the train moved forward up the canon, rising from the bottom of the valley and climbing the sides of the mountains on narrow shelves. The scenery grew wilder and the sleeping members of the party were dragged from their berths and began to appear variously clad in all sorts of garments, from linen suits worn the previous day, during the heat in the valley, to overcoats and blankets. But they were amply repaid for the loss of slumber and a hasty toilet. Stupendous mountains, towering on every side, began to appear, at that early hour in this northern latitude—day began to dawn at 2 a. m. Higher and higher the train climbed up the mountain side, around a "loop" most skilfully located in terraces, almost vertically above each other, until the altitude attained brought us in friendly proximity with the summits of the great peaks all around us, Ross, Cheops and Dix Donald being the most conspicuous. The little river was seen far down in the V-shaped canon, the trestle recently repaired was crossed, and when a turn of the road brought the great Glacier plainly into view, high up on the side of Ross' Peak, daylight had so far advanced that the billows of ice were plainly visible, extending upward toward the clouds in the stupendous masses—great plains of frozen crystal, hundreds of feet in depth.

Other glaciers were seen in the vicinity, but none of such extent or beauty. For many miles up to and through Roger's Pass, the scenery is sublime beyond the power of pen to describe.

Time and space fail to record the interesting features of the descent to the easterly crossing of the Columbia, at Donald, the ascent of the Kicking Horse Pass to the Continental Divide, in the heart of the Rocky Mountains, or the brief stop at Banff, in the Canadian National Park.

At Banff another division of the party took place, and the practical breaking up of "Tour No. 1." Those who were fortunate enough to go on "No. 4" are probably at this writing still enjoying the delights of the Yellowstone Park, but even those who came directly east from Banff have had sufficient grand scenery to last them at least another year.

The convention, as a pleasure excursion, at least, was an unqualified success, and I believe will have no small influence in strengthening the fraternal bonds between the members of the East and the Far West, as well as increase the interest of the engineers of the Pacific Slope in the American Society of Civil Engineers.